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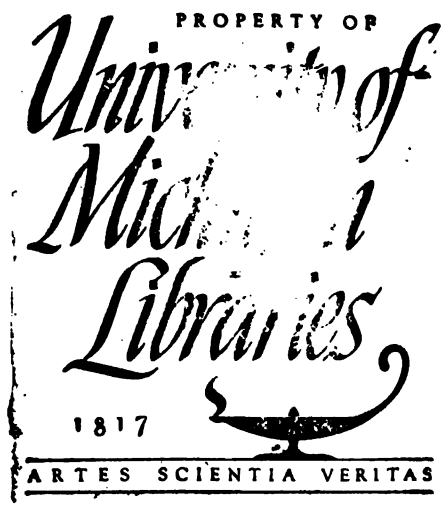
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FOURTH REPORT

OF THE

ILLINOIS HIGHWAY COMMISSION

FOR THE

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LAFAYETTE FUNK, Shirley.

A. N. JOHNSON, *State Engineer.*
T. R. AGG, *Road Engineer.*
C. OLDER, *Bridge Engineer.*

H. E. BILGER, *Division Engineer.*
H. B. BUSHNELL, *Division Engineer.*
B. H. PIEPMEIER, *Division Engineer.*
H. E. SURMAN, *Division Engineer.*

LETTER OF TRANSMITTAL.

SPRINGFIELD, ILL., January 1, 1913.

To the Governor of the State of Illinois:

SIR—We are transmitting to you herewith a copy of the report of the State Highway Commission covering the work done during the years 1910, 1911 and 1912, which has been prepared by the State Engineer, Mr. A. N. Johnson.

While by law no additional powers have been granted to the commission thereby confining the scope of its work practically along those lines already described in previous reports, it will be noted, however, that the amount of the work of nearly every phase has increased, and it is believed the time has come when much larger appropriations and definite powers should be given this commission.

It appears that conditions require the construction on the part of the State of a system of roads, the inception of which should not be longer postponed. We recommend that the State Highway Commission should be as at present, consisting of three members of a non-political character serving without salary.

The task of building a system of roads must necessarily extend over a considerable period of years, and it is believed for the present at least that an issuance of bonds would not be necessary for the amount of work that could be economically handled for the first few years.

The various phases of the work constituting this report, together with the suggestions contained herein are respectfully submitted.

EDMUND J. JAMES, *Chairman.*
JOSEPH R. FULKERSON,
LA FAYETTE FUNK.

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LETTER OF TRANSMITTAL.

SPRINGFIELD, ILL., January 1, 1913.

To the Honorable Board of State Highway Commissioners, Springfield, Ill.:

GENTLEMEN—I beg to submit herewith a report on the work done by the State Highway Commission for the years 1910, 1911 and 1912.

This report has been compiled in collaboration with Messrs. T. R. Agg, road engineer, and C. Older, bridge engineer.

I wish here to take the opportunity to express my appreciation of the splendid coöperation that has been accorded me by every employee of the commission, whose zeal and loyalty have made possible whatever success has been attained.

Very respectfully,

A. N. JOHNSON,

State Engineer.

St. Louis road, Collinsville Township, Madison County. Waterbound macadam. Concrete gutters. General view, see plates Nos. 3 and 17.

INTRODUCTION.

In the following pages will be found a comprehensive outline of the various phases of work undertaken by the Illinois Highway Commission during the years, 1910, 1911 and 1912.

This report will close seven years of active work on the part of the Illinois Highway Commission. The improvement of the public roads of Illinois has been studied from all view points. Information has been gathered, statistics compiled, practical work of a great variety and of considerable extent constructed, and practical experience gained of the needs and possibilities of various methods of construction in all parts of the State.

It has been a part of the policy of the commission to arouse an interest in road improvement among all the people. Some have been reached by reports, some by newspaper and magazine articles, others through lectures and public discussions, while to many the value of modern methods has been forcefully brought by the actual construction of improved roads and bridges.

The greatest and most significant result accompanying this work is the changed view point of many people regarding road improvement. While contributing no small factor in this change of sentiment, it would be but ignorance of the many forces that have been at work to assign too great responsibility for this change to the work of the State Highway Commission. The underlying causes are too many and too subtle for any exact analysis. Whatever the causes, increased use of automobiles, a desire for general improved country life conditions or more efficient transportation on the highways, the time has come when the question of the development of the highways of the State is to be raised for immediate settlement along lines of efficiency and progress, and it is believed that the information gained by the Highway Commission will be of material assistance in arriving at ultimate conclusions.

The following is a brief summary of the results of seven years practical study of the road conditions of Illinois:

First—That the roads of today do not meet today's needs nor give any promise for tomorrow, and constitute a distinct hindrance to the best development of the State, which requires a comprehensive system of improved roads.

Second—Such a system of roads cannot be built, nor maintained even if built, under the present methods of road administration.

Third—It is recognized that the township unit of administration is not adapted for the construction and maintenance of the quality of road surface required by modern traffic.

Fourth—That the construction and maintenance of roads and bridges suitable to meet modern traffic conditions demand the supervision of engineers skilled in this branch of work, and that a system of roads constituting from 15 to 20 per cent of the total road mileage would give to each county when constructed a sufficient mileage of high class roads, the cost of which should be borne by the State and county. And to insure efficiency of this system, past experience in other states has shown that when built, the roads must be maintained by the State.

When such a system of roads is built and maintained by the State, the local communities would find relief from the upkeep of those roads carrying the heaviest traffic and would have then available all of their funds to devote to the neighborhood roads or feeders to the main roads. The road funds for the local roads would be raised in each community in such amounts as may be deemed expedient. At present many townships are unable to maintain even one line of main road where such may pass directly through a township. It is seen that the control of the main roads by the State does not necessitate or include the control of all the neighborhood roads, in fact, it is believed that the control of these roads should be to a large degree a matter for local administration. Such local administration, however, to be efficient, would not follow as a pattern the present methods under township units with three commissioners in each township.

A much more efficient system would result, if instead of three commissioners in each township, there would be, for instance, but one: this man to be in complete control of the actual construction and receive sufficient compensation to devote and expect to devote his whole time to the work, and the road work be primarily his sole business and not a secondary affair as is the case at present.

In order that there would be some system and standard methods of construction followed, there should be in each county a man skilled in highway work, trained as an engineer, to have general control of the work in each township on all the roads save the main roads which would pass under control of the State as fast as actually constructed.

FARMERS' INSTITUTES AND PUBLIC MEETINGS.

The best evidence of public interest in improved roads is the public demand for information on this subject. During the past two or three years no organization has held a public meeting at which public questions were to be discussed, that the road topic did not occupy part of the program. In 1912 there was an exceptionally large number of public meetings called for the sole purpose of discussing road work. For nearly all of these meetings, the State Highway Commission has been requested to furnish speakers, and unless as happened in a few instances when all men available for this kind of work were already similarly engaged all requests have been granted.

The following table gives a summary of the meetings attended each year, since the organization of the State Highway Commission:

Year.	Number public meetings, speakers furnished.
1906	48
1907	111
1908	117
1909	111
1910	127
1911	126
1912	143

The wide distribution of the places where these meetings were held is clearly illustrated by the accompanying map of the State.

As reported in the earlier reports of the commission, the larger proportion of the meetings attended were the county farmers' institutes. There is to be noted at these meetings a gradual change in sentiment so that today a far different view point is taken than was the case some six to eight years ago. At that time, State aid was not looked upon favorably, in fact it was bitterly opposed in most gatherings of farmers, but today it is realized that only by State aid can a systematic, comprehensive scheme of improvements such as is necessary be carried out.

In practically all the meetings attended the work of the State Highway Commission has been explained, the practical workings illustrated and their usefulness shown for each neighborhood. Frequently the lectures have been illustrated with stereopticon views which have added greatly to their interest.

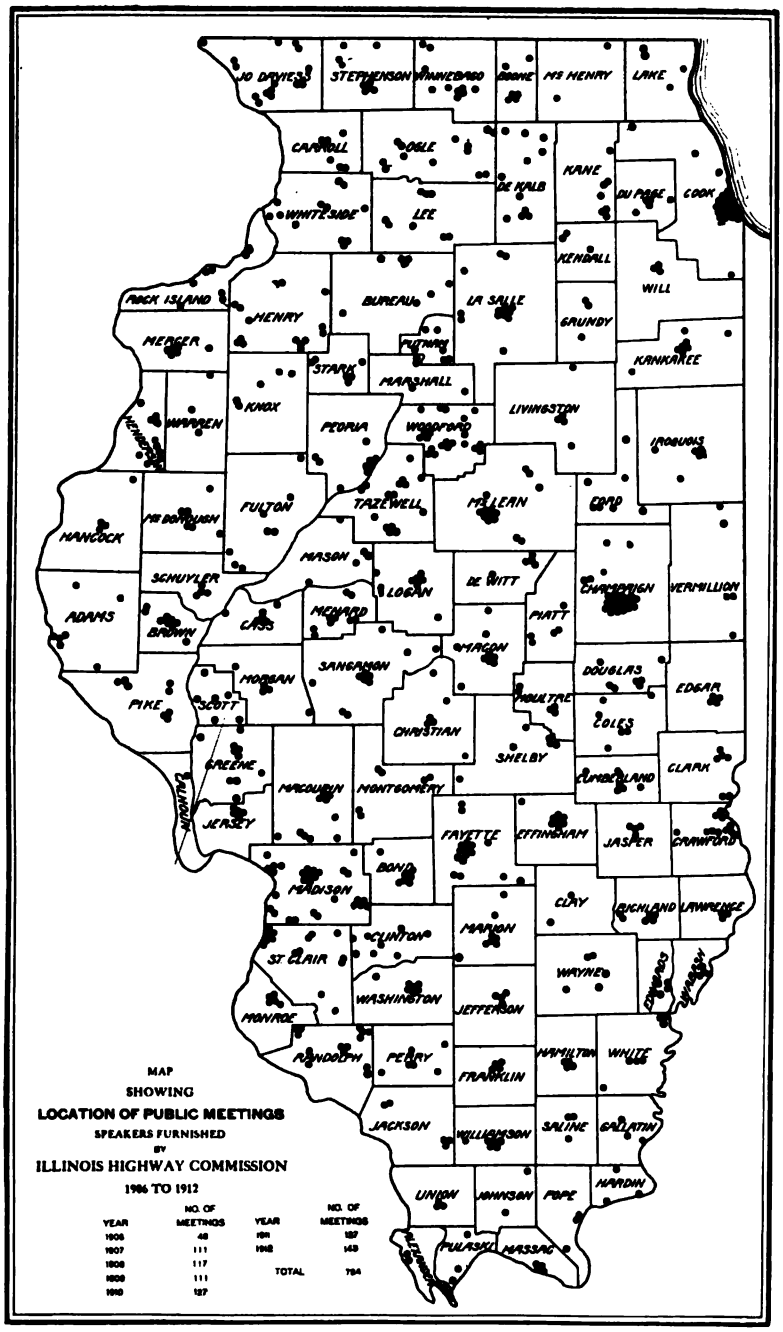


FIG. 1. Showing location of Public meetings.

It has been mainly through the lecture work done at the farmers' institutes that the practical work accomplished by the State Highway Commission has been made possible. As soon as the local officials realized that the most progressive farmers in their community desired the advice of the State Highway Commission to be followed, the local commissioners have not been slow to avail themselves of it.

At all of these meetings, attention has been called to the fact that the State Highway Commission exists for the purpose of providing a force of trained experts in road and bridge construction, who are at the service of the township commissioners and county supervisors of the State, who wish to secure expert advice in regard to any problem of road or bridge construction; and moreover, that this service will be furnished by the State Highway Commission to any board of highway commissioners, or any county board who may make a request for the same without charge.

The following resolutions passed by the State Farmers' Institute at their annual meetings in 1910, 1911 and 1912 will prove of interest as illustrating perhaps better than anything else can do the gradual change in sentiment and increased interest in the work of the State highway department.

Following the resolutions is a report of the committee on roads adopted by the Illinois Farmers' Institute for 1912. This report is worthy of careful reading:

RESOLUTIONS OF THE STATE FARMERS' INSTITUTE, 1910.

WHEREAS, The State Highway Commission has been doing valuable work and giving help and advice to our road officials, therefore be it

***Resolved*, That the State Farmers' Institute, in convention assembled, does again endorse the work of the State Highway Commission and urges all road officials to coöperate with and seek the assistance of the State Commission.**

WHEREAS, The State Highway Commission has built and demonstrated practically the economy of concrete bridges; and,

WHEREAS, The State Highway Commission will furnish, free of cost, plans, estimates, specifications and supervision for bridge construction; therefore, be it

***Resolved*, That the State Farmers' Institute, in convention assembled, urges upon the county supervisors and road commissioners throughout the State that, wherever practicable, they build concrete bridges and secure plans and specifications from the State Highway Commission.**

WHEREAS, Convict labor has been employed successfully in the preparation of crushed stone for road building; therefore, be it

***Resolved*, By the State Farmers' Institute, in convention assembled, that we commend such use of convict labor and that the number of convicts so employed be increased as much as practicable.**

RESOLUTIONS OF THE STATE FARMERS' INSTITUTE, 1911.

WHEREAS, It is a matter of common knowledge that there has been wasted much public money on poor bridge structures, as illustrated by the failure of a large bridge recently erected near Carmi; and,

WHEREAS, Public safety is menaced; and,

WHEREAS, The State Highway Commission has amply demonstrated that safe and durable bridges can be built at reasonable prices if erected under competent supervision; therefore, be it

***Resolved*, That the adequate legislation should be enacted which should place, in the future, the erection of all public bridges under the supervision of the State Highway Commission.**

WHEREAS, It has been impracticable to ship stone for road purposes from the State penitentiaries to but a limited area; and,

WHEREAS, Other sections of the State should receive like benefit; therefore, be it

Resolved, That there should be established additional stone quarries to be operated by convict labor.

WHEREAS, It is generally acknowledged that there must inevitably be much waste under our present system of road administration, whereby competent supervision is impractical; therefore, be it

Resolved, That we approve the appointment of county highway superintendents, who shall have immediate control of all road and bridge work in their respective counties, and that the county superintendent should act in coöperation with and under the advice of the State Highway Commission; be it

Resolved, That we again heartily endorse the work of the Illinois Highway Commission and urge upon the Legislature to increase the appropriation therefor.

RESOLUTIONS OF THE STATE FARMERS' INSTITUTE, 1912.

WHEREAS, The work and influence of the State Highway Commission have proven to be of increasing value to the tax payers; and,

WHEREAS, Many of our road officials have been reluctant to ask and follow the advice of the State Highway Commission; be it

Resolved, That the State Farmers' Institute, in convention assembled, again expresses its confidence in the State Highway Commission; and be it further

Resolved, That we believe our road officials will best serve the tax payers of their respective localities by seeking and following the advice of the State Highway Commission.

WHEREAS, Our road laws enacted many years ago, at a time when primitive ideas on road making prevailed, are entirely inadequate to meet the conditions of the present time. Even with an annual expenditure of nearly seven million dollars upon the roads of this State, road work does not keep pace with other lines of activity, whether on the farm or in the shops, but does fail to meet the insistent demands of today for better highways. We place the blame for these conditions not upon our road officials, but our present road laws which tend to an entire lack of system, and the employment of experienced men in road work, with a consequent waste of public money; therefore, be it

Resolved, That we favor a revision of our State highway laws.

WHEREAS, There have been nearly five hundred bridges of an improved and permanent type successfully built under the supervision of the Illinois Highway Commission; and,

WHEREAS, The state of Wisconsin, by recent legislation, has put the construction of all bridges in that state under the supervision of the Wisconsin Highway Commission; be it

Resolved, That the Illinois State Farmers' Institute recommend to the legislators of Illinois the enactment of a law providing for the supervision, by the Illinois Highway Commission, of all county bridge construction in Illinois.

REPORT OF COMMITTEE ON ROADS, ILLINOIS FARMERS' INSTITUTE, 1912.

In reviewing the subject of road improvement, your committee, as has everyone else who has given the matter any serious attention, has been greatly impressed with the change in our traffic conditions. So rapid has this change been that its effect on public sentiment for the past two years is distinctly noticeable. Communities throughout the State are discussing road improvement from a different viewpoint than ever before. The automobile is becoming a matter of common occurrence in almost every farming community. The farmers in increasing numbers are making use of this

method of transportation. It is proving one of the most notable factors in making home life on the farms more attractive. It increases neighborly intercourse between farm homes, and brings them in more frequent and convenient communication with the towns and villages.

There is little wonder, therefore, that the automobile appeals most strongly to the farmer, not merely as a means of pleasure but as a real factor in increasing the efficiency and happiness of himself and his family. And as road surfaces of an improved character and wide extent are the natural corollary of the automobile, the change in the sentiment and different viewpoint of many people in all parts of the State is made clear.

It has long been seen that the small township unit is totally unable to grasp with the problems of extended, systematic road improvement. This was well illustrated by the number of bills introduced in the last Legislature providing for a more or less radical change in the methods of road administration. And while these bills did not pass, they received and aroused a far greater interest than had ever before been given to any road measures. It was perhaps only natural that the greatest outcry should have been made by those who felt themselves to be most adversely affected.

In the opinion of your committee, however, there is little doubt but that sooner or later there must be some comprehensive legislation, which will permit of more efficient and broader administration of road work. The greatly increased demands made upon the State Highway Commission reflect the appreciation that many communities have for skilled supervision in their road and bridge construction. Communities all over the State have organized meetings to discuss road matters, and in 1911 the Highway Commission was requested to send speakers to 127 such meetings, a large number of these being county farmers' institutes; the total number of meetings that has been attended by the State Highway Commission since 1906, when it was organized being 641. The demands for demonstrations in road building made on the Highway Commission have been increasing in number and already exceed the capacity of the machinery that the commission has available for this purpose. One hundred and one miles of demonstration roads have been built in various parts of the State, and in the past two years particular attention has been given to improved methods of macadam construction involving a bituminous surface.

There have been constructed under the plans and supervision of the State Highway Commission 486 bridges, of which nearly 200 were constructed in 1911. In this work alone it is the opinion of your committee that the State Highway Commission has rendered service to the people of the State many times the value of the total cost of the commission.

In closing this brief report, your committee would urge upon all to give the broadest consideration to road measures which undoubtedly will be brought before the next Legislature, and to bear in mind that such measures to be effective must be framed for the greatest good to the largest number, and that the sooner such methods are put in practice, the sooner will the benefits accrue to each one.

A factor which is rapidly making for highway improvement and one which your committee considers of very great importance is the large and more persistent use of the road drag together with efficient road drainage. In several sections throughout the State the inauguration and proper use of the drag has revolutionized dirt road conditions. It is impossible to expect, and much less advocate, the construction of stone or hard roads in anything like all the communities of the State. At the best only the main highways and those most traveled can, at least anywhere soon, be converted into permanent roads. Permanent roads must necessarily come slowly and it will take years before they can replace to any very great extent the universal system of earth roads. This being the case, your committee would take this opportunity to call attention and especially recommend and urge the more general adoption and use of road drags in all road districts of the State. We beleive the road drag an excellent and intensely practical means to the end of better

public highways. We would not be understood as offering this recommendation as a substitute for the extension of permanent roads, or of minimizing in any degree the importance and vital need of more hard roads, but simply as an important step toward local earth road improvement which is possible in every community. We believe in the road drag and its general application in the improvement and maintenance of all earth highways. We would urge its wider recognition and use.

We further believe a change in the law permitting the labor of persons convicted of crimes to be used in constructing permanent highways would be a wise addition to our present road law.

The following table gives a list in detail of the meetings that were attended during the years of 1910, 1911 and 1912; the date and place of holding these meetings together with the association under whose auspices the meeting was held are shown:

TABLE No. 1.

Meetings Attended in 1910.

Date.		County.	Town.	Association.
Jan.	3	Fayette	Ramsey	County Farmers' Institute
	3	Woodford	Washburn	do
	4	Woodford	Metamora	do
	4	Fayette	Shobonier	do
	4	Winnebago	Durand	do
	5	Winnebago	Pecatonica	do
	5	Fayette	Brownstown	do
	5	Woodford	Benson	do
	6	Woodford	Roanoke	do
	6	Fayette	St. Peter	do
	7	Marion	Alma	do
	8	Carroll	Milledgeville	do
	12	Whiteside	Coleta	do
	12	Piatt	Bement	do
	13	DuPage	Wheaton	do
	13	Kankakee	Herscher	do
	13	Boone	Belvidere	do
	14	Clark	Marshall	do
	14	Livingston	Pontiac	do
	26-28	Pulaski	Cairo	Ill. Society Engineers & Surveyors
Feb.	4	Iroquois	Watseka	County Farmers' Institute
	4	Kankakee	Grant Park	do
	5	Grundy	Morris	do
	7	White	Grayville	Commissioners' meeting
	8	White	do	County Farmers' Institute
	9	LaSalle	Ottawa	State Farmers' Institute
	10	LaSalle	do	do
	11	Cass	Beardstown	Citizens' meeting
	11	Macon	Decatur	County Farmers' Institute
	11	Henry	Annawan	do
	12	Fayette	Ramsey	do
	12	Madison	Godfrey	Citizens' meeting
	15	Alexander	Cairo	State Retail Merchants Association
	15	Menard	Athens	County Farmers' Institute
	16	Menard	Greenview	do
	17	Menard	Tallula	do
	18	Menard	Petersburg	do
	19	Jersey	Jerseyville	Jersey Co. Good Roads Association
	22-23	Madison	Edwardsville	State Farmers' Institute
	22-23	Madison	do	do
	23	Cook	Chicago	City Engineers' meeting
	24	Cook	do	do
Mar.	2	Champaign	Champaign	Meeting of Freshmen Engineers
	5	Adams	Mendon	Commissioners' meeting
	7	LaSalle	Earlville	Good roads meeting
	8	LaSalle	Streator	Citizens' meeting
	9	Champaign	Champaign	Meeting of County Highway Commissioners
	11	Knox	Altona	Citizens' good road meeting
	12	Knox	Galesburg	Good roads meeting
	12	Stephenson	Orangeville	do
	14	Macon	Decatur	Citizens' meeting
	14	Macon	Forsythe	Farmers' meeting
	14	Whiteside	Albany	Commissioners' meeting
	16	Macon	Maroa	Good roads meeting
	28	Peoria	Peoria	Retail merchants' meeting

Table No. 1—Concluded.

Date.	County.	Town.	Association.
Apr. 2	Lee	Sublette	Good roads meeting
7	Beatrice	Nebraska	Nebraska good roads meeting
8	Omaha	Nebraska	Commercial Club meeting
May 3	LaSalle	Ottawa	Good roads meeting
13–14	Cook	Chicago	National Highway League
17	Madison	Marine	Citizens' meeting
June 3	Will	Joliet	Chamber of Commerce meeting
July 8	Cook	Chicago	Letter Carriers' Assn. meeting
15	McLean	Normal	County Teachers' Assn
22	Vermilion	Danville	Supervisors' meeting
Aug. 5	Madison	Alhambra	Road Improvement Assn. meeting
17	Champaign	Champaign	Commissioners' meeting
18	Madison	Collinsville	Farmers' Picnic
24	Champaign	Mahomet	Road Improvement Assn. meeting
26	DeWitt	Farmer City	do
31	Madison	Fosterburg	County Farmers' Institute
Sept. 1	McLean	LeRoy	Good roads meeting
2	Madison	Highland	Talk at County Fair
14	Tazewell	Morton	County Farmers' Institute
21	Tazewell	Deer Creek	do
27	Madison	Edwardsville	Good roads meeting (banquet)
28	Ogle	Stillman Valley	County Farmers' Institute
Oct. 3–4	McLean	Bloomington	Chamber of Commerce meeting
3–4	McLean	do	Township commissioners' annual meeting
12	Fulton	Cuba	County Farmers' Institute
12	Stark	Wyoming	do
13	Tazewell	Green Valley	do
13	Fayette	Vandalia	Good roads meeting
13	Mason	Kilbourne	County Farmers' Institute
14	Macon	Blue Mound	Corn Show
18	Saline	Raleigh	County Farmers' Institute
19	Hardin	Cave-in-Rock	do
20	Bond	Greenville	do
20	Gallatin	Junction	do
20	Cass	Virginia	do
21	Williamson	Marion	do
22	Franklin	Benton	do
22	Vermont	Fulton	Public meeting
25	Sangamon	New Berlin	County Farmers' Institute
31	Sangamon	Illiopolis	Public meeting
Nov. 2	Fayette	Vandalia	County Farmers' Institute
3	Effingham	Effingham	do
4	Clinton	Albers	do
8	Jefferson	Mt. Vernon	do
9	Randolph	Coulterville	do
9	Richland	Noble	do
10	Perry	Duquoin	do
10	Wabash	Mt. Carmel	do
11	Marion	Salem	do
16	Madison	Mitchell	do
17	Madison	Highland	do
18	Madison	Bethalto	Public meeting
25	Tazewell	Pekin	Woman's Club
Dec. 1	Christian	Taylorville	County Farmers' Institute
6	Whiteside	Garden Plain	do
6	Crawford	Palestine	do
7	Whiteside	Tampico	do
8–9	Indianapolis		American Road Makers' Assn
7	Jasper	Newton	County Farmers' Institute
8	Lee	Sublette	do
9	Ogle	Holcomb	do
13	Beatrice	Nebraska	Gage County Farmers' Institute
14	Logan	Lincoln	County Farmers' Institute
14	Omaha	Nebraska	Road convention
16	Champaign	Mahomet	County Farmers' Institute
16	Johnson	Burnside	do
21	Champaign	Champaign	Lecture to Freshman Class Engineers
21	Mercer	Aledo	County Farmers' Institute
22	Bureau	Princeton	do
22	McDonough	Macomb	do

Total, 127 meetings.

TABLE NO. 2.

Meetings Attended in 1911.

Date.		County.	Town.	Association.
Jan.	4	Vermilion	Ridge Farm	County Farmers' Institute
	4	Edgar	Paris	do
	5	Woodford	ElPaso	do
	5	Champaign	Rising	Public meeting, township commissioners
	6	Woodford	Minonk	County Farmers' Institute
	7	Woodford	Benson	do
	7	Douglas	Newman	do
	9	Woodford	Roanoke	do
	10	Carroll	Chadwick	do
	10	Woodford	Green Township	do
	10	Henderson	Biggsville	do
	11	Piatt	Cerro Gordo	do
	11	Henderson	Media	do
	11	Boone	Belvidere	do
	11	Woodford	Washburn	do
	12	Stephenson	Lena	do
	12	Stephenson	Freeport	do
	12	Woodford	Metamora	do
	12	Henderson	Raritan	do
	12	Winnebago	Rockford	do
	13	McLean	Lexington	do
	13	Greene	Greenfield	do
	13	Kendall	Plano	do
	14	Kankakee	Manteno	do
	14	Whiteside	Coleta	do
	14	Henderson	Stronghurst	do
	14	Woodford	Eureka	do
	14	Bureau	Ohio	do
	17	Wichita	Kansas	State Road Association
	19	Lincoln	Nebraska	do
	24–27	Madison	East St. Louis	Illinois Society of Engineers
	30	Christian	Pana	Public meeting, Commercial Association
Feb.	8	Champaign	Rantoul	County Farmers' Institute
	8	Ford	Piper City	do
	9	Tazewell	Delavan	do
	9	Iroquois	Watseka	do
	9	Ford	Sibley	do
	10	Ford	Paxton	do
	14	Lake	Antioch	do
	15	Lake	Antioch	do
	16	Lawrence	St. Francisville	do
	16	Cape Girardeau	Missouri	County engineers
	17	White	Grayville	County Farmers' Institute
	17	Cook	Barrington	do
	21	LaSalle	Ottawa	do
	23–25	St. Louis	Missouri	State Highway Engineers
Mar.	1	Vermilion	Rossville	Public meeting
	3	Montgomery	Nokomis	Automobile Club
	6	Hancock	LaHarpe	Public meeting
	11	Effingham	Beecher City	do
	13	Morgan	Jacksonville	Public meeting, Business Men's Association
	17	Hancock	Carthage	Public meeting
	18	Madison	Troy	do
	31	Fulton	Astoria	do
Apr.	8	Peoria	Peoria	Township Highway Commissioners Assn., Peoria Co.
	10	Cass	Chandlerville	Public meeting
	18	Effingham	Windsor	Public meeting, township commissioners
	15	Kankakee	Kankakee	Kankakee Good Roads Association
May	13	Putnam	Magnolia	Public meeting, business men and commissioners
	16	Warren	Monmouth	Banquet, Western Automobile Association
June	17	Clay	Flora	Public meeting
	20	St. Clair	Belleville	Commercial Club
	26	Ford	Gibson	Board Local Improvement
	28	Randolph	Chester	Millers' Association
July	28	Shelby	Shelbyville	Commercial Association
Sept.	1	Pike	Hadley	Farmers' Exchange
	4	Peoria	Alta	Grange Picnic
	6	Fayette	Farina	County Farmers' Institute
	14	Brown	Mt. Sterling	Merchants' Carnival
	20	Knox	Galesburg	Auto races
	30	Ogle	Polo	Auto Club meeting
Oct.	4	Macon	Decatur	State Highway Commissioners Convention
	13	Wayne	Jeffersonville	County Farmers' Institute
	14	Edwards	Albion	do
	19	Bond	Greenville	do
	20	Williamson	Marion	do

Table No. 2—Concluded.

Date.		County.	Town.	Association.
Oct.	20	Madison	Alton	County Farmers' Institute
	20	Pulaski	Mound City	do
	21	Alexander	Thebes	do
	26	Sangamon	Buffalo	do
	28	Columbia	Missouri	Dedication of Missouri Cross-State Highway
Nov.	3	McDonough	Macomb	Business men's meeting
	4	McDonough	do	do
	4	Ogle	Monroe Center	Woman's Club
	6	Scott	Bluffs	County Farmers' Institute
	7	Scott	Manchester	do
	8	Scott	Glasgow	do
	8	Clinton	New Baden	do
	9	Scott	Bloomfield	do
	9	Clinton	Beckemeyer	do
	10	Scott	Mt. Pleasant	do
	10	Fayette	Vandalia	do
	11	Scott	Winchester	do
	11	St. Clair	Lebanon	do
	18	Franklin	Benton	do
	23	White	Carmi	do
	20	Richmond	Virginia	American Association Highway Improvement
	24	Hamilton	McLeansboro	County Farmers' Institute
	25	Wayne	Fairfield	do
	27	Fulton	Lewistown	Local Improvement Club
Dec.	5	Greene	Whitehall	County Farmers' Institute
	5	DeKalb	Kirkland	do
	6	Effingham	Effingham	do
	6	DeKalb	Kingston	do
	6	Greene	Carrollton	do
	6	Greene	Hillview	do
	7	Crawford	Hutsonville	do
	7	Greene	Kane	do
	7	DeKalb	Genoa	do
	8	Richland	Olney	do
	8	DeKalb	Sycamore	do
	9	DeKalb	Malta	do
	11	Fulton	Lewistown	Lewistown Good Roads Club
	12	Mason	SanJose	County Farmers' Institute
	12	Bureau	Walnut	do
	12	DeKalb	Elva	do
	13	Ogle	Mt. Morris	do
	13	DeKalb	Waterman	do
	14	DeKalb	Shabbona	do
	14	Mercer	Aledo	do
	15	Putnam	Granville	do
	15	McLean	Cooksville	do
	15	DeKalb	Hinckley	do
	16	DeKalb	Sandwich	do
	19	Champaign	Champaign	Engineers' Club of State University
	20	Champaign	do	Freshman Class, College of Engineers, Univ. of Illinois

Total, 126 meetings.

Table No. 3.

Meetings Attended in 1912.

Date.		County.	Town.	Association.
Jan.	1	Randolph	Steeleville	Special road meeting
	4	Marion	Centralia	Talk at Chamber of Commerce Banquet
	5	Henry	Geneseo	Farmers' Institute
	6	DeKalb	Waterman	Road meeting
	9	Henry	Woodhull	County Farmers' Institute
	18	Champaign	Champaign	Engineering Society
	18	Champaign	do	Illinois Society C. E
	18	Menard	Greenview	County Farmers' Institute
	18	Will	Joliet	do
	19	Champaign	Champaign	Freshman Class of Engineering
	19	Menard	Tallula	County Farmers' Institute
	19	Champaign	Champaign	Illinois Society C. E
	19	McLean	Lexington	County Farmers' Institute
	19	Alexander	Cairo	Southern Illinois Lumbermen's Convention
	19	Champaign	Champaign	Illinois Society C. E
	20	Menard	Athens	County Farmers' Institute
	21	Champaign	Champaign	Lecture at university
22-	23	Champaign	do	Lectures at short course
	24	Champaign	do	Corn Growers & Stockmen's Convention
	25	Indiana	Indianapolis	Indiana Engineering Society
	26	Tazewell	Tremont	Special road meeting
	26	Champaign	Champaign	Short course lecture
	27	Effingham	Effingham	Special road meeting

Table No. 3—Continued.

Date.		County.	Town.	Association.
Feb.	2	Carroll	Milledgeville	Road meeting
	3	Rock Island	Orion	do
	3	Rock Island	Coal Valley	do
	6	JoDaviess	Apple River	County Farmers' Institute
	7	Henry	Kewanee	do
	7	JoDaviess	Galena	do
	8	JoDaviess	East Dubuque	do
	8	Rock Island	Coal Valley	do
	9	Kendall	Plano	do
	9	JoDaviess	Hanover	do
	10	JoDaviess	Elizabeth	do
	14	Jackson	Carbondale	Good roads meeting
	15	Wisconsin	Madison	Engineers' Society
	16	Stephenson	Winslow	County Farmers' Institute
	17	Douglas	Tuscola	Hard roads meeting
	20	Tazewell	Delavan	County Farmers' Institute
	20-21	Marion	Centralia	State Farmers' Institute
	23	LaSalle	Ottawa	Special road meeting
	23	Ogle	Creston	Good roads meeting
	24	Douglas	Hindsboro	Road meeting
	26-27	Cook	Chicago	American Highway League meeting
	29	Massac	Metropolis	Good roads meeting
Mar.	1	Williamson	Marion	do
	2	Fayette	Vandalia	do
	2	Randolph	Red Bud	do
	6	Madison	Granite City	Commercial Club
	7	Madison	Alton	Alton Commercial Association
	7	Putnam	Granville	Special road meeting
	8	Putnam	Magnolia	do
	9	Putnam	McNabb	do
	11	Madison	New Douglas	do
	12	Cook	Chicago	Citizens' meeting
	13	LaSalle	Ottawa	Good roads meeting
	14	Tazewell	Pekin	Commercial Club
	28	Effingham	Effingham	Good roads meeting
	29	JoDaviess	Elizabeth	do
	30	JoDaviess	Stockton	do
Apr.	3	Ogle	Rochelle	Road meeting
	4	Whiteside	Deer Grove	Good roads meeting
	15	Cook	Chicago	Engineers' meeting
	16	Lawrence	Lawrenceville	Special road meeting
	18	Washington	Nashville	Good Roads Convention
	19	Effingham	Effingham	Good Roads Club
	20	Massac	Metropolis	Good roads meeting
May	1	Marshall	Henry	do
	1	Clark	West Union	Hard roads meeting
	2	Cumberland	Greenup	Road Convention
	3	JoDaviess	Elizabeth	Road meeting
	7	Michigan	Ann Arbor	Engineers' meeting
	14	Macoupin	Bunker Hill	Special road meeting
	21	Pike	Griggsville	Road meeting
	22	Macoupin	Staunton	do
	29	Carroll	Mt. Carroll	do
June	3	Randolph	Steeleville	do
	20	Fayette	Vandalia	do
	27	Winnebago	Harlem	do
	28	Winnebago	Winnebago	do
July	17	Woodford	El Paso	Public meeting
	18	Mercer	Aledo	Public meeting
Aug.	8	Madison	Edwardsville	Rural Letter Carriers' Association
	23	Lawrence	Lawrenceville	Public meeting
	30	Pike	Hadley	Special meeting
Sept.	11	DuPage	Elmhurst	Public meeting called by Auto Club
	12	Cook	Chicago Heights	Meeting called by Auto Club
	21	Madison	Edwardsville	Centennial celebration
	27	Peoria	Peoria	Good roads meeting
Oct.	1-5	New Jersey	Atlantic City	American Road Congress
	9	Morgan	Jacksonville	State Postmasters' Convention
	10	Madison	Highland	National Road Association Convention
	10	Mason	San Jose	County Farmers' Institute
	10	Cumberland	Toledo	do
	10	Shelby	Windsor	do
	16	Edgar	Paris	State Farmers' Institute
	16	Moultrie	Sullivan	County Farmers' Institute
	16	Bond	Greenville	do
	18	Madison	Alhambra	do
	22	Knox	Victoria	do
	22	Rock Island	Port Bryon	do
	24	Macoupin	Gillespie	do
	24	Pope	Golconda	do

Table No. 3—Concluded.

Date.	County.	Town.	Association.
Oct. 25	Rock Island	Rock Island	Road meeting
25	Massac	Metropolis	County Farmers' Institute
26	Morgan	Waverly	do
Nov. 7	Cook	Chicago	Engineers' Club
7	Perry	Pinckneyville	County, Farmers' Institute
9	Randolph	Evansville	do
12	Monroe	Waterloo	County Farmers' Institute
13	Champaign	Homer	Road meeting
13	Washington	Nashville	County Farmers' Institute
14	Clinton	Germantown	do
14	Hardin	Elizabethtown	do
14	Clay	Louisville	do
14	St. Clair	Marissa	do
15	Gallatin	Shawneetown	do
15	Williamson	Marion	do
15	Edwards	Browns	do
16	Ogle	Monroe Center	Road meeting
18	Alexander	Cairo	State Farmers' Institute
21	Madison	Troy	Road meeting
21	Macoupin	Carlinville	do
25	St. Clair	East St. Louis	do
30	McLean	Bloomington	do
Dec. 1-4	Ohio	Cincinnati	Road Convention
3	Crawford	Hutsonville	County Farmers' Institute
4	Crawford	Palestine	do
10	Madison	Collinsville	Road meeting
10	Lee	Dixon	County Farmers' Institute
10	Henderson	Raritan	do
10	Whiteside	Lyndon	do
11	New York	New York	Cement Manufacturers' Association
11	Henderson	Biggsville	County Farmers' Institute
11	Stark	Toulon	do
12	New York	New York	Columbia University
12	Lee	Amboy	County Farmers' Institute
12	Henderson	Oquawka	do
12	Bureau	Ohio	do
12	Cook	Norwood Park	Road meeting
13	Ogle	Mt. Morris	County Farmers' Institute
14	Montgomery	Raymond	do
19	Winnebago	Rockford	do

Total, 143 meetings.

ORGANIZATION OF TOWNSHIP HIGHWAY WORK.

In many states the political unit that has charge of local road maintenance is the town.

In outlining an organization for building and maintaining public highways in a town or a political unit of a similar size, certain definite assumptions must be made and those enumerated below probably apply in a general way to such units throughout the United States as well as to Illinois in particular.

The mileage of roads to be cared for is assumed to be from 75 to 100, of which approximately 75 per cent are earth roads; the bridges and culverts are to be in the care of the same organization as the roads.

It is also assumed that the town officials do not have charge of the maintenance or construction of sections of heavily traveled through roads that may lie in the town, but that these main roads form a part of a State system under the maintenance of a State Highway Department.

A reasonable amount of money is to be available for the work to be done, and it is assumed that macadam or other hard roads are to be built by contract and that all bridges costing to exceed $400.00 to $500.00 are to be built by contract. For convenience in the discussion, the unit for which the organization is designed is designated as the town throughout.

THE TOWN ROAD COMMISSIONER.

The entire responsibility for the work in the town should be in the hands of one man designated as the town road commissioner. He should be elected by the voters of the town for a term of three years on a nonpartisan ballot under a system whereby the man having the highest number of votes is declared elected to the office. His pay should be a fixed percentage of the regular road and bridge levy of the town, about ten per cent, but in no case should be less than $200.00 per year nor exceed $500.00.

It is expected his duties will be administrative only and require but one or two days' time a month on an average. There should be one fixed day each month when he may be found at a designated office in the town, on which days contracts should be let and other business transacted. He should be custodian of the town road funds. In order to safeguard his

expenditures he should be required to publish a list of disbursements each quarter. The town road commissioner should have full charge of all road work in the town, make all contracts for road work and for bridges for the township and should be obliged to hire a road superintendent. He should be subject to a properly safeguarded recall.

The actual work on the highways would be in charge of a road superintendent, to be employed or appointed by the town road commissioner, and to be responsible only to him. The road superintendent should be employed by the year on a monthly wage basis, being required to give his entire time to road work. He should be custodian of the equipment owned by the town and be responsible for its care and upkeep. He should have authority to hire such men and teams as may be necessary for doing the road work in the town, subject only to approval of the town road commissioner.

The men and teams used on the road work should be so far as possible employed on a monthly wage basis and for the entire construction season, and should be under authority of the superintendent, take orders and report directly to him.

All taxes for road and bridge purposes in each town should be paid in cash, the maximum rate allowable to be fixed by statute, but within such limits the rate should be fixed by the road commissioner, such rate to be entered by the proper county officers as a tax against all property in the town, including railroads and other corporations situated therein.

The evils of the labor system are too well known to need detailed mention. There are few communities where a valid excuse can be offered for any such inefficient and demoralizing method of doing public work.

FRANCHISES FOR RIGHTS OF WAY.

It is believed that no franchise for rights of way within the public highways should be at the disposal of as small a unit as the town but could well be extended, under proper statutory limitations, by the county boards. Franchises for electric railroads within the limits of a highway should be prohibited by the law except within the limits of incorporated villages and cities.

It is with such larger matters affecting the welfare of the town and its highways that the highway commissioner should deal and the office so constituted as to permit the best equipped men, the busy men, the men of affairs, to be able and desirous of undertaking the work. The duties should not include a lot of small detail much better left to some skillful superintendent.

EQUIPMENT.

The following equipment can usually be economically used in an average town. A power grading outfit, i. e. some kind of power tractor and heavy grader, a small grader for team work, ten to fifteen road drags, and the usual equipment of small scrapers, shovels, plows, picks and similar tools.

In exceptional cases the town may use economically, particularly if there is a considerable mileage of hard roads to be maintained, the following additional equipment: One or two conveniently located gravel pits or stone quarries, and in the latter case a stone crushing plant with a capacity of 100 cubic yards per day, a concrete mixer and collapsible culvert forms.

PATROLLING THE ROADS.

All of the roads in the town except possibly a few infrequently traveled by-roads, should be patrolled once a month by the road superintendent. Special inspection trips may be necessary in addition to the regular monthly patrolling, but these will involve only visits to certain sections of roads which have been reported as being in improper condition. In addition to patrolling all the roads once a month, the road superintendent should patrol the main traveled roads in the town at least once a week.

CONSTRUCTION WORK ON ROADS.

All construction work in the way of grading and shaping of earth roads should be done early in the season, the work beginning as soon as the roads have settled sufficiently to permit the use of proper machinery. In this work, the road superintendent should act as foreman, and be in immediate charge of the construction work and give his time continuously to it.

The work should be done by the most approved and efficient methods, using a grader drawn by some sort of a power tractor, and the work should be planned so as to inconvenience the public as little as possible, consistent with doing economical work. If heavy grading, as cutting hills or raising roads by means of embankments, must be done, the work should be laid out and grades established by a competent engineer, and the superintendent should then work to the grade so established, using teams and scrapers. Such work should be done as early in the season as practical, so as to permit the newly made embankments to be compacted before the winter season comes on. All such work can conveniently be done by day labor with the regular force employed in road work.

CONSTRUCTION WORK ON CULVERTS.

After the necessary earth work on the roads has been completed, the force should take up the construction and repair of culverts. This work can be conveniently done in midsummer and early fall. At this time the streams are usually at low water and the work will be interrupted the least by rainy weather and high water in the streams. Plans should be made and materials purchased for all the work which it is intended to do in one season, and this work should all be done at one time, the township gang working continuously at the culvert work until it has been completed.

In many instances the town might well adopt a general type of culvert, and if once a satisfactory type were decided upon, this could be used

throughout the town, thereby permitting the use of forms repeatedly, and making it unnecessary for the town force to become familiar with more than one general type of construction. In this way, the greatest efficiency of the men could be secured at the least expenditure for superintendence.

BRIDGE WORK.

The construction of all bridges or culverts having a span of 6 feet or greater should be in accordance with general specifications as established by the State Highway Department. The plans and specifications should be prepared during the winter, and the contracts let in the early spring. The construction of the bridges should be carried out under the supervision of an inspector, and approved by the engineer. Mention is made of bridge work later on.

MAINTENANCE OF EARTH ROADS.

After the earth road construction work has been completed in the early summer, a certain amount of grade work will be necessary in order to maintain the proper shape to the roads during settlement. Such work will usually be done by teams and a lighter grader, and arrangements should be made by the town superintendent to follow the construction work with a proper amount of grading so as to maintain the condition of the surface and the general shape of the roads until the roadway has become thoroughly compacted.

In addition to the maintenance work which can be done with a small grader, there will be a large amount of maintenance work to be done by means of the split log or other similar forms of drag. Inasmuch as the dragging must usually be done throughout the town within a period of a very few hours, if the work is to be accomplished while the soil is in proper condition, it will be necessary for the road superintendent to have men who live in various parts of the township employed for this purpose with the understanding that they will drag certain sections of road immediately upon receipt of notice from the superintendent. When the superintendent finds conditions are suitable for dragging, he will then notify the various men throughout the town and the work of dragging can be done within a few hours.

In order to have efficient dragging work done this arrangement is necessary, particularly in the early fall and winter when it often freezes suddenly after a heavy rain, making the roads very rough unless they have been dragged just before freezing.

It is very important to maintain a perfect system of drainage on all roads throughout the year, and it is particularly desirable to have the roads enter the winter-and-spring period without obstructions to drainage anywhere. Late in the fall the roads should be gone over and all culverts cleaned out, weeds and grass removed from the ends and the ditches along the roads throughout carefully cleaned and opened so as to insure a free flow of water to the culverts and outlet ditches.

MAINTENANCE OF HARD ROADS.

Maintenance work on hard roads should be carried out in midsummer except that emergency repairs should be made at any time when it seems advisable. The general overhauling or surfacing of any section of hard roads can be most conveniently and economically done in spring or early fall, and under the operation of systematic maintenance most of the necessary work can be done by means of small tools, such as picks, shovels and tampers, without the use of the steam roller or other heavy appliances.

The construction of hard roads may be carried on by contract. Plans and specifications for the work should be prepared by a competent engineer and the construction should be carried out under suitable inspection by the engineer, or inspector approved by him. The contracts should be let in the early spring, and if the roads are to be surfaced with a bituminous compound, provisions should be made for the completion of the work prior to October 1st, or at least provisions should be made that no work should be done when the atmospheric temperature is less than 60 degrees.

MAINTENANCE OF BRIDGES.

It is expected that the organization will take care of the necessary maintenance of bridges, such as reflooring and repainting and provisions should be made for taking care of this work in the late summer.

In outlining a system for maintaining highways in a small political unit, it is believed to be desirable to concentrate the responsibility for the work on one person, and if this is done, then the one person who is responsible for the work must also be given full authority, therefore, the road commissioner should have full authority for carrying on the work in the town.

First class work can only be expected when men are compensated for it. Therefore, the compensation for the men doing road work in the town should be ample for the class of work they are required to do, and particularly the superintendent should be well paid. The success of the operation of the entire system will depend upon the selection of a suitable town commissioner and in accordance with the ideals of a representative government, it is believed that this officer should be elected by the people, with the full realization that in some cases incompetent men will be elected.

By making the office non-partisan, competent men will usually be secured for this position. Since the commissioner is to be held responsible for all the work in the township, he must have full authority in securing his assistants, and all men doing road work and all inspectors working in the town should report to the town commissioner. Inasmuch as the office will entail the handling of considerable sums of money, the road commissioner should be placed under a suitable bond, and the disbursement of this fund should be placed under proper legal safeguards such as the one requiring vouchers covering all expenditures to be kept on file and should be required to publish at least once a quarter a state-

ment showing all the expenditures during the preceding quarter, including expenditures for supplies and expenditures for labor, salaries, etc. It is also believed that the office should be made subject to recall upon petition and vote of the people in the town.

PUBLIC LETTING OF CONTRACTS.

The commissioner should be required by law to let all contracts for road and bridge work after public advertisements and at public lettings, and upon properly prepared plans and specifications. He should also be required to purchase all supplies amounting to more than a certain maximum in any month by advertisement and public letting of contract.

It is intended that the position be one of business management, and that it shall not necessarily be a technical position, therefore, provisions should also be made by law for the proper engineering supervisions of any work done in the town which requires technical skill not to be expected of the commissioner.

GENERAL ORDER OF WORK.

The various classes of work that ought to be done in a township, can be so arranged that a regular force of employees can be kept busy throughout those months of the year when weather conditions permit construction work. This force can be large or small, depending upon the condition of the roads in the town and the amount of traffic, and consequently the amount of maintenance necessary, but whether be it large or small, it should be maintained as nearly as possible throughout the construction season so as to take full advantage of the expertness and experience which the men will obtain in doing the class of work required of them.

It is often found that contracts for construction work can be most advantageously let in the winter or early spring prior to the season in which the work is to be done. Contractors usually can at that time make more satisfactory arrangements for materials than later on in the season and will sometimes be willing to bid closely so as to insure themselves of a big volume of work for the season.

Several kinds of road work necessary in town can be done about as well at one time of the year as another, while other kinds ought to be done at certain seasons in the year, and between these the town crew can be kept constantly working during the year. For example, earth work, grading and shaping of roads should be done as early in the season as possible, and it may be convenient at the same time to finish any incomplete drainage work, such as the opening up of ditches or the laying of tiles. Or it may be found that the latter work can be more conveniently postponed until later in the season. Likewise in the repair of water-bound macadam or gravel roads, there is no great difference between doing the work early in the spring or later in the fall, but in general, the work cannot be conveniently and economically done in midsummer, because the proper repairs of the road require that they shall be kept wet

until traffic has thoroughly compacted the portion that has been repaired, and ordinarily this will entail some additional expense if the work is done in exceedingly hot dry weather. If, however, the work is done in the early spring when there are frequent rains or late in the fall when there are rains and the weather is cool, it will be much easier to maintain the moist condition necessary to secure cementing of the road material.

On the other hand, if there are bituminous surface roads to be repaired, the work can be more satisfactorily done in the hotter part of the season. In the same way, the repair of culverts can be taken care of at any time during the year, but during the midsummer and early fall, the streams are more nearly dry and there will be the least delay on account of rain and high water in the streams.

MACHINERY.

Some kinds of machinery that could be economically used in a larger unit cannot be economically used in a town on account of the fact that the depreciation of these tools during the longer part of the year they are not in use will more than make up for the saving effected by their limited use. For example, if the township has a number of small culverts to construct, it might be economical to purchase and use a small concrete mixer. A small mixer can be purchased for $300.00 or $400.00 which will save nearly one dollar per cubic yard of concrete placed so that if 300 or 400 cubic yards are to be used in one or two seasons a small mixer will be found profitable, while a larger mixer suitable for larger work would seldom be economical for a town to own. Likewise, if a town has a large mileage of macadam roads to be maintained, it might be worth while to have a power roller for use in maintaining the macadam road. But, if on the other hand, a small mileage is to be taken care of, the work can be done with the ordinary small tools in a satisfactory manner, although not as cheaply as by use of the roller.

If road materials are expensive when shipped into the township, then it might be advisable to maintain a quarry and crushing plant, but if materials can be obtained on board cars in the town at a price of $1.00 or $1.25 per cubic yard, it would not pay the township to maintain a crushing plant. If a considerable amount of gravel or crushed stone roads are to be maintained, it would be advisable for the town to own and use special dumping wagons which could be drawn by the tractor and used for hauling material for these roads.

If the type of soil and general characteristics of the roads of the township are such as to permit the use of a power leveler which can take the place of the drag to a large extent, then this machine will be economical to use. But if the soil is of such a nature that it cannot be traveled by a tractor drawing a leveler at the time of year when the leveler should be used, it will be necessary to resort to the use of the drag drawn by teams, and a power tractor and the leveler would not be an economical piece of machinery for the town to maintain.

On light clay soils the leveler is not recommended but with heavy sticky clay and gumbo soils, a leveler can be used to good advantage.

In general, with the class of supervision it will be possible to obtain in any town, no very complicated system of construction or maintenance can be worked out successfully. A system of organization which will give high efficiency in a larger unit under more expert supervision might fail entirely in a small unit or at least become inefficient. It is believed that the most can be accomplished by concentrating responsibility and authority in one man. When responsibility is fixed there is much gained in results. A town road commissioner selected by the people of his community is easily accessible, and if his work is not satisfactory, it will be comparatively easy to reach him and secure relief from the disagreeable or undesirable features of his administration.

COUNTY CO-OPERATION.

In the foregoing discussion of the work to be done in a town comprising, as has been assumed, a comparatively small mileage of roads, it is seen that there is work that requires special engineering supervision and equipment, that it is not practical for such a small unit as a town to provide.

To have available such engineering supervision and such equipment, a larger unit than the town seems necessary. Such a unit is furnished by the county and there should be a county highway engineer appointed by the county board to have general charge of all road and bridge work requiring engineering supervision. The county should own an equipment of the more expensive machinery, such as rollers, bituminous spreading machines and concrete mixers as might be efficiently employed on those roads requiring such apparatus. This equipment to be under the immediate supervision of the county engineer, to be assigned by him to work in the different towns.

A pre-determined fixed per diem charge sufficient to operate and maintain this machinery should be ascertained by the county engineer, which charge should be defrayed by the county and by the town actually using the same.

The county engineer should draw and approve all plans for roads and bridges in the county exclusive of those upon the main system of roads, including from 15 to 20 per cent of the road mileage and which is to be under direct control of the State Highway Department.

The general specifications for all bridges should be furnished by the State Highway Department, these specifications to be used and followed by the county engineer in his design for individual bridges.

The smaller concrete bridges that require, not to exceed 100 to 150 cubic yards of concrete, could well be constructed by day labor under the immediate direction of the county engineer, the county to furnish on such work, a concrete mixer, special collapsible forms, where such can be used, and an inspector to superintend the work, this portion of the construction to fall upon the county; the cost of all labor and materials to be furnished by the town. The initiative for such work to be taken by the town commissioner.

With a system of State roads, under State maintenance, to care for the more heavily traveled, and consequently more expensive to maintain,

with a county engineer at hand to direct the more important work on the secondary roads and the roads of lesser importance, but including the larger mileage, to be maintained as such community can best afford, a system of road maintenance and improvement is obtained that is well adapted to the needs of today with reasonable provision for the future.

CRUSHED STONE PREPARED AT THE PENITENTIARIES.

STATUTE CONCERNING CONVICT LABOR AND ROAD MATERIALS.

An Act to amend section 2 of an Act entitled "An Act authorizing and empowering the employment of convicts and prisoners in the penal and reformatory institutions of the State of Illinois in the manufacture of tile and culvert pipe for road drainage purposes, and in the manufacture of machinery, tools and appliances for the building, maintaining and repairing of the wagon roads of the State, and for preparing road building and ballasting material, upon the requisition of the State Highway Commission," approved May 18, 1905, in force July 1, 1905.

SECTION 1. *Be it enacted by the People of the State of Illinois, represented in the General Assembly*, That section 2 of an Act entitled, "An Act authorizing and empowering the employment of convicts and prisoners in the penal and reformatory institutions of the State of Illinois in the manufacture of tile and culvert pipe for road drainage purposes, and in the manufacture of machinery, tools and appliances for the building, maintaining and repairing of the wagon roads of the State, and for preparing road building and ballasting material, upon the requisition of the State Highway Commission," approved May 5, 1905, in force July 1, 1905, be and the same is hereby amended so as to read as follows:

SEC. 2. The commissioners of highways in any township in counties under township organization or the commissioners of highways or boards of county commissioners in counties not under township organization may make application to the said State Highway Commission for such road building material, tile, culvert pipe, road making machinery, tools and other appliances as may be needed or required by them for the construction, improvement or repairing of the wagon roads in their respective townships or road districts, and where by agreement of the commissioners of highways in counties under township organization, or the commissioners of highways or boards of county commissioners in counties not under township organization, as the case may be, with the city council of any city, or the board of trustees of any village within the limits of such town, any gravel, rock, macadam or other hard road is extended within or through the corporate limits of such city or village then for the construction, improvement or repairing of so much of said road as lies within the corporate limits of such city or village, provided such extension within such city or village shall be of the same cost and kind of material as the road outside such city or village, obligating themselves to use such material according to the rules and regulations formulated and approved by the State Highway Commission.

Approved June 3, 1907.

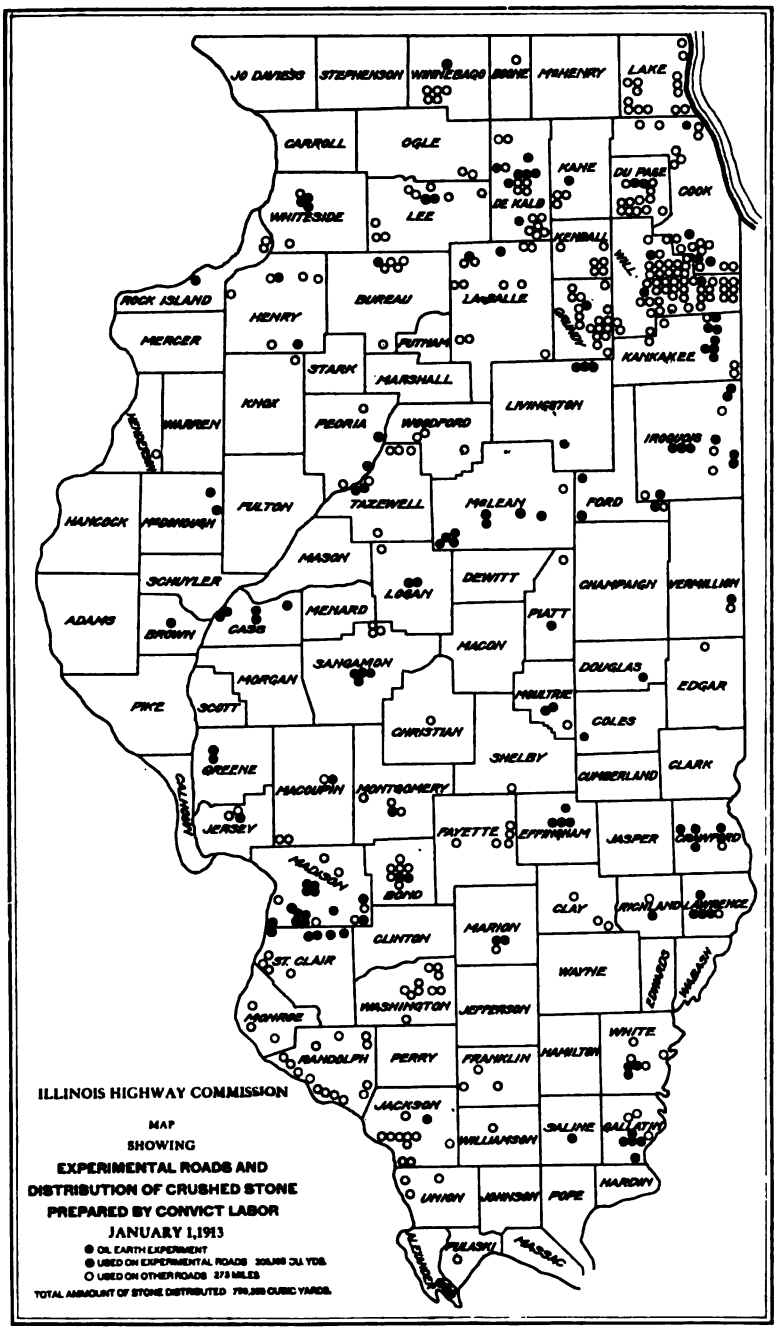

JO DAVIESS
STEPHENSON
WINNEBAGO
BOONE
MCHENRY
LAKE
CARROLL
OGLE
KANE
DU PAGE
COOK
WHITESIDE
LEE
DE KALB
KENDALL
WILL
ROCK ISLAND
HENRY
BUREAU
LA SALLE
GRUNDY
MERCER
PUTNAM
KANKAKEE
STARK
MARSHALL
KNOX
LIVINGSTON
WARREN
PEORIA
WOODFORD
IROQUOIS
HENDERSON
HANCOCK
MCDONOUGH
FULTON
TAZEWELL
MCLEAN
FORD
MASON
SCHUYLER
LOGAN
DEWITT
CHAMPAIGN
VERMILLION
ADAMS
BROWN
CASS
MENARD
PIATT
MACON
SANGAMON
MORGAN
DOUGLAS
EDGAR
PIKE
SCOTT
MOULTRIE
CHRISTIAN
COLES
SHELBY
GREENE
CUMBERLAND
CLARK
CALHOUN
MACOUPIN
MONTGOMERY
JERSEY
FAYETTE
EFFINGHAM
JASPER
CRAWFORD
MADISON
BOND
CLAY
RICHLAND
LAWRENCE
CLINTON
MARION
ST. CLAIR
WAYNE
EDWARDS
WABASH
WASHINGTON
JEFFERSON
MONROE
RANDOLPH
PERRY
FRANKLIN
HAMILTON
WHITE
JACKSON
WILLIAMSON
SALINE
GALLATIN
UNION
JOHNSON
POPE
HARDIN
ALEXANDER
PULASKI
MASSAC
ILLINOIS HIGHWAY COMMISSION
MAP
SHOWING
EXPERIMENTAL ROADS AND
DISTRIBUTION OF CRUSHED STONE
PREPARED BY CONVICT LABOR
JANUARY 1, 1913
OIL EARTH EXPERIMENT
USED ON EXPERIMENTAL ROADS
USED ON OTHER ROADS 273 MILES
TOTAL AMMOUNT OF STONE DISTRIBUTED

FIG. No. 2.

REVISED LAW CONCERNING THE USE OF FREE MACADAM.

The law which provides for the distribution of crushed stone, prepared at the penitentiaries, has been amended so that this material may be used inside the corporate limits of villages and cities, provided it is used in extending a road from the township into the corporation, and that the township officials give their consent for the material to be so used.

DISTRIBUTION OF CRUSHED STONE PREPARED AT THE PENITENTIARIES.

The tables at the end of this chapter summarize the results of the preparation and distribution of crushed stone from the State penitentiaries.

During the three years covered by this report a number of applications for crushed stone had to be considered which had been filed prior to 1910, but upon which no shipments had been made as there was insufficient material available. These applications which were carried over, together with those received during the three years, have constituted a demand for crushed stone far in excess of the supply. In the distribution of the material available, every effort has been made to supply each township making application for crushed stone with material enough for at least a mile of road. In a great many cases it has been impossible to furnish townships with the full amount they have applied for, and in some cases townships have not been supplied with any material at all. This is due primarily to the fact that at the time the material was available these townships were not in position to handle it. Later when the townships were ready to take the material, the supply had been assigned to other places. The significant fact in connection with these requests that have been received is that a great many townships now file applications annually for the supply of crushed stone used in their township for that year. This indicates that the employment of convict labor for the manufacture of road materials is meeting with general approval and that the distribution of the penitentiary stone, as it is being carried out, is materially assisting a great many communities to develop a system of hard roads.

Attention has been called in previous reports to the fact that if all parts of the State are to receive the benefit from this free stone for road purposes, it will be necessary to have a wider distribution of the material. This is impossible under the present conditions, as the freight rates are such as to exclude certain zones in the State from receiving material from either penitentiary, and if this method of distribution is to be carried to its logical conclusion, and convict labor utilized largely in the preparation of road material, it will be necessary to establish quarries in other parts of the State, so that those sections which are now too far removed from either of the existing quarries to get the material, may receive a supply.

It should be again emphasized that the employment of convicts for this purpose does not place any additional tax burden on the people of the

State, and such employment of the convicts is generally approved by the prison officials, so that it is difficult to see how a more equitable plan for assisting township road construction could be devised.

EXTENT OF DISTRIBUTION OF CRUSHED STONE.

A study of the following tables will show that during 1910 applications for crushed stone were received from 53 townships in 35 counties; a total of 143,800 cubic yards being applied for, that during 1911 applications were received from 58 townships in 33 counties, and that a total of 214,000 cubic yards were applied for, and that in 1912 applications were received from 88 townships in 44 counties and that a total of 263,195 cubic yards were applied for.

As in previous years, the material has been furnished to township officials under two general plans of coöperation; one where only general supervision is furnished by the State Highway Commission, and one where the road is constructed directly under the supervision of an engineer in the employ of the State Highway Commission, and the work done with machinery owned by the commission, and loaned to the township; the latter being so-called experimental roads.

HOW TO APPLY FOR CRUSHED STONE.

According to the law, crushed stone is furnished to township officials who make application for it to the State Highway Commission. These applications for crushed stone should be made on the forms prepared for that purpose which will be furnished upon request by the State Highway Commission. These applications when received are given a serial number and placed on file to be taken up for shipment in their turn. The application should always be accompanied by a letter stating at about what time the commissioners can most conveniently use the material, and every effort is made to furnish it at that time.

Many conditions are encountered in the shipment of crushed stone, however, which often make it impossible to furnish the materials at the time requested. There are certain seasons in the year when it is very difficult to secure coal cars for loading, and there are other times when weather conditions make it practically impossible for the township to handle the material, although it is possible to furnish it to them. On the whole, however, it is believed that the distribution has been carried out with fairness to the various townships applying for the material, and that as township officials appreciate the various conditions which are encountered in making shipments they can adjust their plans so as to take material at the most advantageous time.

During the past years there has been a number of townships that have received a considerable quantity of crushed stone during the winter months, storing it for use when the construction season opens in the spring. This may seem at first to be an added expense and double handling of material. As a matter of fact, however, the additional expense when material is handled in this way is comparatively small, and in addition the township is assured of a supply of stone for their work.

It has been repeatedly demonstrated that if material is shipped ahead and piled in a storage pile along a siding, and then reloaded into wagons in the summer and hauled on the road, that the cost of this rehandling is practically eliminated by saving due to the greater regularity with which the work can be carried on. Those who have been engaged in this form of road construction, are familiar with the delays which are usually encountered on account of irregular receipt of crushed stone. This often necessitates the stoppage of the work in the middle of the morning, or in the middle of the afternoon, and makes it impossible to employ a regular force of men and teams throughout the job. With the constant changing of men and teams, and the delays on account of non-arrival of material, there is always additional expense. But if there is on hand a storage pile which can be worked on when there are no cars to be unloaded, the road work can be carried along continuously with a force of men who will soon become familiar with the work, and will become much more efficient than if they were changed from day to day. Moreover, the interruption to traffic will be greatly decreased because the work will proceed more rapidly.

The demand for the penitentiary stone is constantly increasing, and it will be necessary for an increasing number of townships to take the material during the winter and store it if they are to receive it at all.

ROADS CONSTRUCTED WITHOUT THE USE OF A HEAVY ROLLER.

A considerable amount of the crushed stone which is furnished from year to year is placed by the township commissioners according to general instructions issued by the Illinois Highway Commission, which do not require the use of a heavy roller for compacting the stone. Where the instructions for such work are intelligently followed, very satisfactory results are obtained.

The essential features of such construction are a well drained and well shaped foundation to place the stone upon, the uniform spreading of the crushed stone, the proper width and alignment of the earth shoulders, which hold the bed of stone in place and the proper drainage of the road bed by means of lateral drains filled with stone.

The critical time in the life of such a road is during the first year or two after it is built, particularly the first year. After the crushed stone has been placed and covered with screenings and the road opened for traffic, it is inevitable that ruts will form along the wheel track, and if these ruts are allowed to remain in the surface of the road they will hold water and cause its rapid deterioration. If however, the ruts which form when the road is first put into service are filled with stone and the surface kept smooth by means of a drag or road grader, the stone will finally compact to form a smooth, even, durable surface.

If the road is constructed with stone from the Joliet penitentiary, instead of the screenings to fill voids, a good bonding gravel is very much better and even if screenings are used, the surface of the road should be covered to a depth of about one inch with a good quality of gravel. This gravel, however, should not contain too great a percentage of clay

or loam, because if there is a large quantity of clay in the gravel, it will become sticky during wet weather and cause the stone to pull out of the surface of the road on the wheels.

Emphasis is placed on the fact that if the surface of the road is to become fit for traffic, it should be repeatedly smoothed during the first year of service, and after that time it will require comparatively little attention. It is impossible to construct a stone road which will not require attention, and those townships which are getting the most satisfactory results from the construction of their roads, are those where a systematic effort is made to keep the road in condition from year to year. A small amount of repair work each season on the various roads will prevent any serious deterioration in them, and will maintain them in a satisfactory condition indefinitely. The best material to keep the surface in good condition is a good grade of bonding gravel which should not run over 1 inch in size. It should be spread very thin upon the road where it shows wear. Repairs of this nature should be made early in the spring so as to leave the surface well bonded before hot, dry weather. Too much emphasis, however, can not be put on the necessity for giving the roads due attention from year to year if they are to remain in satisfactory condition.

Figure No. 2 is a map of the State showing to what extent geographically the crushed stone prepared by convict labor has been distributed, while the following tables give the amounts received by each locality:

TABLE No. 4.

General Distribution of Crushed Stone Prepared by Convict Labor.

Year.	Number of counties to which stone was sent.	Number of townships to which stone was shipped.	Cubic yards of stone shipped.
1910	42	67	103,309
1911	40	80	152,165
1912	43	90	154,032

TABLE NO. 5.

Applications for Crushed Stone.

1910.

County.	Township.	Amount —cubic yards.
Bond	Burgess	75
Bond	Central	4,500
Bureau	Ohio	10,000
Cass	Road District No. 3	3,000
Clay	Louisville	200
Cook	Northfield	700
Cook	Rich	3,000
Crawford	Honey Creek	3,000
Crawford	Oblong	2,000
DeKalb	DeKalb	6,000
DeKalb	South Grove	1,700
Effingham	Douglas	2,500
Fayette	Avena	600
Gallatin	Bowlesville	2,500
Greene	Whitehall	3,500
Grundy	Braceville	9,000
Grundy	Felix	2,000
Henry	Geneseo	3,000
Iroquois	Beaver	3,000
Iroquois	Pigeon Grove	2,000
Kankakee	Pembroke	300
Lake	West Deerfield	3,000
LaSalle	Adams	3,000
LaSalle	Eden	1,000
LaSalle	Earl	4,500
Lawrence	Bridgeport	3,000
Lee	China	3,000
Logan	East Lincoln	75
McDonough	Mound	3,000
Macoupin	Carlinville	3,000
Madison	Collinsville	3,000
Madison	Edwardsville	600
Madison	Marine	6,000
Madison	Nameoki	3,000
Marion	Salem	2,000
Ogle	Flagg	1,000
Ogle	Mt. Morris	1,500
Pulaski	Road District No. 3	1,000
Randolph	Road District No. 10	750
Randolph	Road District No. 13	600
Randolph	Road District No. 3	250
St. Clair	O'Fallon	5,000
Sangamon	State Fair grounds	2,200
Tazewell	Pekin	3,500
Washington	Nashville	780
White	Carmi	2,000
Whiteside	Mt. Pleasant	6,000
Will	Frankfort	5,500
Will	Lockport	2,500
Will	Reed	500
Will	Wilmington	2,000
Will	Wilton	6,000
Winnebago	Winnebago	2,000
Total amount applied for		143,830

Table No. 5—Continued.

1911.

County.	Township.	Amount —cubic yards.
Bond	Central	3,800
Cass	Road District No. 3	2,500
Clay	Clay City	3,000
Cook	Bloom	2,000
Cook	Maine	3,000
Cook	Northfield	5,000
Cook	Norwood Park	675
Cook	Palos	1,000
Cook	Rich	3,600
DeKalb	Malta	3,500
DuPage	Milton	2,000
Fayette	St. Elmo	125
Ford	Drummer	3,000
Ford	Sullivant	3,000
Franklin	Tyrone	50
Gallatin	Ridgway	2,000
Grundy	Felix	2,500
Grundy	Morris	875
Jackson	Sand Ridge	800
Kankakee	Ganier	2,000
Kankakee	Momence	2,000
Kankakee	Yellowhead	4,000
Kendall	NaAussay	2,000
Kendall	Seward	2,000
Lake	Warren	2,000
Lake	Waukegan	2,000
Lake	Benton	600
LaSalle	Adams	3,000
LaSalle	Allen	3,000
LaSalle	Eden	1,000
LaSalle	Ottawa	100
Lee	Alto	640
Lee	China	4,000
Lee	Marion	1,200
Lee	Nachusa	1,700
McLean	Arrowsmith	200
McLean	Bloomington	6,000
McLean	Blue Mound	25,000
Marion	Meacham	50
Monroe	Road District No. 9	2,000
Ogle	Buffalo	250
Ogle	Flagg	2,500
Peoria	Akron	2,000
Randolph	Road District No. 12	250
Randolph	Road District No. 13	544
Randolph	Road District No. 3	5,000
Rock Island	South Moline	3,000
St. Clair	Lebanon	4,000
St. Clair	O'Fallon	1,000
St. Clair	Sugar Loaf	1,000
Shelby	Dry Point	100
Tazewell	Washington	2,000
Tazewell	Pekin	4,000
Washington	Beaucoup	100
Washington	Nashville	3,000
White	Carmi	100
White	Hawthorne	1,500
Whiteside	Morrison	3,000
Will	Crete	30,000
Will	Florence	8,500
Will	Jackson	1,000
Will	Joliet	10,000
Will	Manhattan	3,375
Will	Monee	1,800
Will	New Lenox	4,500
Will	Reed	1,000
Will	Wilton	10,000
Woodford	Metamora	4,000
Total amount applied for		214,434

Table No. 5—Continued.

1912.

County.	Township.	Amount —cubic yards.
Alexander	Road District No. 7	4,000
Bond	Burgess	300
Bond	Central	2,500
Boone	Boone	500
Cass	Road District No. 8	200
Clay	Clay City	3,000
Clay	Harter	2,000
Clinton	Carlyle	5,500
Coles	Mattoon	4,000
Cook	Barrington	4,625
Cook	Bremen	2,500
Cook	Elk Grove	2,000
Cook	Leyden	2,000
Cook	Maine	10,000
Cook	Norwood Park	3,000
Cook	Rich	4,700
Cook	Thornton	1,500
Crawford	LaMotte	3,000
Cumberland	Neoga	60
DeKalb	Clinton	1,000
DeKalb	Somonauk	4,000
DeKalb	South Grove	1,500
DeKalb	Victor	2,000
Douglas	Effingham	2,500
DuPage	Naperville	2,000
DuPage	York	1,000
Fayette	Avena	600
Ford	Patton	2,000
Franklin	Browning	1,000
Gallatin	Shawnee	2,000
Grundy	Wauponsee	1,000
Henry	Geneseo	3,000
Iroquois	Crescent	50
Iroquois	Middleport	3,200
Jackson	Road District No. 2	300
Jackson	Carbondale	10,000
Jackson	Fountain Bluff	2,100
Jackson	Grand Tower	4,000
Kendall	Kendall	2,000
Lake	Benton	300
Lake	Cuba	3,500
Lake	East Deerfield	19,000
Lake	Shields	3,000
Lake	West Deerfield	5,500
LaSalle	Utica	2,500
Lawrence	Bridgeport	2,000
Lawrence	Lawrence	5,000
Lee	China	3,000
Lee	Nelson	700
Livingston	Indian Grove	2,700
Logan	East Lincoln	2,500
Macoupin	Carlinville	2,000
Madison	Collinsville	2,500
Madison	Edwardsville	1,000
Madison	Helvetia	4,000
Madison	Olive	500
Madison	Omphghent	300
Madison	Venice	1,250
Marion	Kinmundy	6,800
McDonough	Bushnell	100
McLean	Anchor	2,500
McLean	Blue Mound	1,000
McLean	Dale	6,000
McLean	Mt. Hope	2,000
Monroe	New Hanover	60
Montgomery	Hillsboro	3,200
Ogle	Buffalo	500
Ogle	Dement	5,000
Ogle	Flagg	1,000
Randolph	Road District No. 7	1,000
Randolph	Road District No. 13	1,000

Table No. 5—Continued.

1911.

County.	Township.	Amount —cubic yards.
Bond	Central	3,800
Cass	Road District No. 3	2,500
Clay	Clay City	3,000
Cook	Bloom	2,000
Cook	Maine	3,000
Cook	Northfield	5,000
Cook	Norwood Park	675
Cook	Palos	1,000
Cook	Rich	3,600
DeKalb	Malta	3,500
DuPage	Milton	2,000
Fayette	St. Elmo	125
Ford	Drummer	3,000
Ford	Sullivant	3,000
Franklin	Tyrone	50
Gallatin	Ridgway	2,000
Grundy	Felix	2,500
Grundy	Morris	875
Jackson	Sand Ridge	800
Kankakee	Ganier	2,000
Kankakee	Momence	2,000
Kankakee	Yellowhead	4,000
Kendall	NaAussay	2,000
Kendall	Seward	2,000
Lake	Warren	2,000
Lake	Waukegan	2,000
Lake	Benton	600
LaSalle	Adams	3,000
LaSalle	Allen	3,000
LaSalle	Eden	1,000
LaSalle	Ottawa	100
Lee	Alto	640
Lee	China	4,000
Lee	Marion	1,200
Lee	Nachusa	1,700
McLean	Arrowsmith	200
McLean	Bloomington	6,000
McLean	Blue Mound	25,000
Marion	Meacham	50
Monroe	Road District No. 9	2,000
Ogle	Buffalo	250
Ogle	Flagg	2,500
Peoria	Akron	2,000
Randolph	Road District No. 12	250
Randolph	Road District No. 13	544
Randolph	Road District No. 3	5,000
Rock Island	South Moline	3,000
St. Clair	Lebanon	4,000
St. Clair	O'Fallon	1,000
St. Clair	Sugar Loaf	1,000
Shelby	Dry Point	100
Tazewell	Washington	2,000
Tazewell	Pekin	4,000
Washington	Beaucoup	100
Washington	Nashville	3,000
White	Carmi	100
White	Hawthorne	1,500
Whiteside	Morrison	3,000
Will	Crete	30,000
Will	Florence	8,500
Will	Jackson	1,000
Will	Joliet	10,000
Will	Manhattan	3,375
Will	Monee	1,500
Will	New Lenox	4,500
Will	Reed	1,000
Will	Wilton	10,000
Woodford	Metamora	4,000
Total amount applied for		214,434

Table No. 5—Continued.

1912.

County.	Township.	Amount —cubic yards.
Alexander	Road District No. 7	4,000
Bond	Burgess	300
Bond	Central	2,500
Boone	Boone	500
Cass	Road District No. 8	200
Clay	Clay City	3,000
Clay	Harter	2,000
Clinton	Carlyle	5,500
Coles	Mattoon	4,000
Cook	Barrington	4,625
Cook	Bremen	2,500
Cook	Elk Grove	2,000
Cook	Leyden	2,000
Cook	Maine	10,000
Cook	Norwood Park	3,000
Cook	Rich	4,700
Cook	Thornton	1,500
Crawford	LaMotte	3,000
Cumberland	Neoga	60
DeKalb	Clinton	1,000
DeKalb	Somonauk	4,000
DeKalb	South Grove	1,500
DeKalb	Victor	2,000
Douglas	Effingham	2,500
DuPage	Naperville	2,000
DuPage	York	1,000
Fayette	Avena	600
Ford	Patton	2,000
Franklin	Browning	1,000
Gallatin	Shawnee	2,000
Grundy	Wauponsee	1,000
Henry	Geneseo	3,000
Iroquois	Crescent	50
Iroquois	Middleport	3,200
Jackson	Road District No. 2	300
Jackson	Carbondale	10,000
Jackson	Fountain Bluff	2,100
Jackson	Grand Tower	4,000
Kendall	Kendall	2,000
Lake	Benton	300
Lake	Cuba	3,500
Lake	East Deerfield	19,000
Lake	Shields	3,000
Lake	West Deerfield	5,500
LaSalle	Utica	2,500
Lawrence	Bridgeport	2,000
Lawrence	Lawrence	5,000
Lee	China	3,000
Lee	Nelson	700
Livingston	Indian Grove	2,700
Logan	East Lincoln	2,500
Macoupin	Carlinville	2,000
Madison	Collinsville	2,500
Madison	Edwardsville	1,000
Madison	Helvetia	4,000
Madison	Olive	500
Madison	Omphghent	300
Madison	Venice	1,250
Marion	Kinmundy	6,800
McDonough	Bushnell	100
McLean	Anchor	2,500
McLean	Blue Mound	1,000
McLean	Dale	6,000
McLean	Mt. Hope	2,000
Monroe	New Hanover	60
Montgomery	Hillsboro	3,200
Ogle	Buffalo	500
Ogle	Dement	5,000
Ogle	Flagg	1,000
Randolph	Road District No. 7	1,000
Randolph	Road District No. 13	1,000

Table No. 5—Concluded.

1912.

County.	Township.	Amount —cubic yards.
Tazewell	Deer Creek	2,000
Vermilion	Butler	250
Washington	Ashley	2,000
Washington	Hoyleton	2,000
White	Carmi	2,000
White	Emma	400
Whiteside	Fulton	2,000
Whiteside	Mt. Pleasant	7,000
Will	Florence	5,000
Will	Frankfort	3,000
Will	Homer	25,000
Will	Lockport	6,000
Will	Manhattan	6,000
Will	Monee	1,500
Will	Reed	2,000
Will	Wesley	3,000
Winnebago	Winnebago	2,000
Total amount applied for		263,195

Table No. 6.

Summary of Shipments of Crushed Stone.

1910.

Month.	Joliet —cubic yards.	Menard —cubic yards.
January		3,589
February	242	1,554
March		4,631
April	6,179	4,830
May	8,105	4,187
June	7,800	4,174
July	7,505	3,452
August	9,397	2,352
September	7,310	2,207
October	7,608	2,410
November	4,642	2,917
December	7,319	899
Total	66,107	37,202
Total output for 1910		103,309

Table No. 6—Concluded.

1911.

Month.	Joliet —cubic yards.	Menard —cubic yards.
January	6,668	2,730
February	8,003	3,558
March	12,570	4,279
April	9,402	4,534
May	9,702	4,299
June	9,134	5,439
July	9,406	4,924
August	11,087	4,538
September	4,824	4,851
October	8,216	5,065
November	8,461	2,713
December	6,701	1,041
Total	104,174	47,991
Total output for 1911	.....	152,165

1912.

Month.	Joliet —cubic yards.	Menard —cubic yards.
January	4,552	1,020
February	5,274	2,534
March	6,771	1,456
April	8,138	3,348
May	10,695	2,670
June	9,860	4,044
July	8,813	4,625
August	13,214	5,686
September	12,413	6,222
October	11,287	6,948
November	5,379	4,439
December	10,239	4,405
Total	106,635	47,397
Total output for 1912	.....	154,032

Table No. 7—Concluded.

1912.

County.	Township.	Cubic yards of stone.
Bond	Burgess	163
Bond	Central	4,850
Boone	Boone	505
Bureau	Ohio	453
Clay	Clay City	77
Cook	Barrington	486
Cook	Bremen	2,387
Cook	Maine	2,470
Cook	Palos	1,183
Cook	Rich	4,118
DeKalb	Clinton	954
DeKalb	DeKalb	117
DeKalb	Somonauk	1,462
DeKalb	South Grove	1,110
DeKalb	Victor	1,150
DuPage	Milton	156
DuPage	Naperville	1,548
DuPage	York	1,465
Fayette	Avena	316
Ford	Patton	591
Franklin	Browning	578
Grundy	Braceville	3,137
Grundy	Morris	623
Grundy	Wauponsee	888
Iroquois	Crescent	42
Jackson	Fountain Bluff	370
Jackson	Grand Tower	163
Jackson	Road District No. 2	319
Jackson	Sand Ridge	311
Kendall	Kendall	1,182
Kendall	Seward	537
Lake	Cuba	2,700
Lake	Shields	515
Lake	Ela	2,018
Lake	West Deerfield	3,406
LaSalle	Adams	1,048
LaSalle	Allen	1,738
LaSalle	Eden	604
LaSalle	Ottawa	109
LaSalle	Utica	1,721
Lawrence	Lawrence	258
Lee	Alto	851
Lee	China	2,145
McLean	Blue Mound	348
Madison	Helvetia	203
Madison	Olive	366
Monroe	Road District No. 9	440
Montgomery	Hillsboro	1,131
Ogle	Buffalo	252
Peoria	Akron	1,404
Randolph	Road District No. 3	390
Randolph	Road District No. 13	166
Randolph	Ellis Grove	164
Randolph	Modoc	106
Rock Island	Canoe Creek	84
Tazewell	Pekin	608
Tazewell	Deer Creek	362
Washington	Hoyleton	530
Washington	Nashville	196
Washington	Ashley	116
White	Emma	132
Will	Crete	433
Will	Florence	2,634
Will	Frankfort	2,760
Will	Joliet	2,961
Will	Lockport	3,092
Will	Peotone	209
Will	Reed	1,004
Will	Wesley	1,633
Will	Wilton	1,941
Winnebago	Winnebago	2,029
Total for 1912		76,518

Table No. 7—Continued.

1911.

County.	Township.	Cubic yards of stone.
Bond	Central	1,796
Bureau	Ohio	4,499
Clay	Clay City	655
Cook	Bloom	1,590
Cook	Bremen	3,681
Cook	Maine	2,423
Cook	Northfield	2,565
Cook	Norwood Park	294
Cook	Orland	2,764
Cook	Rich	2,651
Crawford	Honey Creek	1,887
DeKalb	Sandwich	898
DeKalb	Somonauk	369
DuPage	Lisle	659
DuPage	Milton	2,245
Fayette	Avena	1,074
Franklin	Tyrone	32
Gallatin	Ridgway	1,634
Grundy	Braceville	4,594
Grundy	Felix	2,498
Grundy	Morris	2,132
Grundy	Wauponsee	1,007
Henderson	Raritan	149
Iroquois	Middleport	1,829
Iroquois	Pigeon Grove	112
Jackson	Grand Tower	2,967
Jackson	Sand Ridge	1,293
Kankakee	Pembroke	403
Kendall	Seward	86
Lake	Benton	713
Lake	Waukegan	3,555
Lake	West Deerfield	2,829
LaSalle	Adams	2,075
LaSalle	Allen	3,150
Lee	Marion	1,537
Lee	Nachusa	690
Monroe	Road District No. 9	220
Ogle	Flagg	1,916
Randolph	Ft. Gage	100
Randolph	Road District No. 13	221
Randolph	Road District No. 12	75
Randolph	Road District No. 3	891
Rock Island	Canoe Creek	126
Sangamon	Williams	352
Shelby	Dry Point	57
St. Clair	Sugar Loaf	996
Tazewell	Washington	1,903
Washington	Beaucoup	100
Washington	Hoyleton	1,190
Washington	Nashville	3,161
White	Carmi	64
White	Hawthorne	4,023
Winnebago	Winnebago	1,245
Will	Crete	2,236
Will	Florence	3,445
Will	Lockport	89
Will	Manhattan	1,958
Will	Peotone	427
Will	Reed	202
Will	Symerton	212
Will	Wilmington	616
Will	Wilton	906
Woodford	Metamora	2,568
Total for 1911		92,634

Table No. 7—Concluded.

1912.

County.	Township.	Cubic yards of stone.
Bond	Burgess	163
Bond	Central	4,850
Boone	Boone	505
Bureau	Ohio	453
Clay	Clay City	77
Cook	Barrington	486
Cook	Bremen	2,387
Cook	Maine	2,470
Cook	Palos	1,183
Cook	Rich	4,118
DeKalb	Clinton	954
DeKalb	DeKalb	117
DeKalb	Somonauk	1,462
DeKalb	South Grove	1,110
DeKalb	Victor	1,150
DuPage	Milton	156
DuPage	Naperville	1,548
DuPage	York	1,465
Fayette	Avena	316
Ford	Patton	591
Franklin	Browning	578
Grundy	Braceville	3,137
Grundy	Morris	623
Grundy	Wauponsee	888
Iroquois	Crescent	42
Jackson	Fountain Bluff	370
Jackson	Grand Tower	163
Jackson	Road District No. 2	319
Jackson	Sand Ridge	311
Kendall	Kendall	1,182
Kendall	Seward	537
Lake	Cuba	2,700
Lake	Shields	515
Lake	Ela	2,018
Lake	West Deerfield	3,406
LaSalle	Adams	1,048
LaSalle	Allen	1,738
LaSalle	Eden	604
LaSalle	Ottawa	109
LaSalle	Utica	1,721
Lawrence	Lawrence	258
Lee	Alto	851
Lee	China	2,145
McLean	Blue Mound	348
Madison	Helvetia	203
Madison	Olive	366
Monroe	Road District No. 9	440
Montgomery	Hillsboro	1,131
Ogle	Buffalo	252
Peoria	Akron	1,404
Randolph	Road District No. 3	390
Randolph	Road District No. 13	166
Randolph	Ellis Grove	164
Randolph	Modoc	106
Rock Island	Canoe Creek	84
Tazewell	Pekin	608
Tazewell	Deer Creek	362
Washington	Hoyleton	530
Washington	Nashville	196
Washington	Ashley	116
White	Emma	132
Will	Crete	433
Will	Florence	2,634
Will	Frankfort	2,760
Will	Joliet	2,961
Will	Lockport	3,092
Will	Peotone	209
Will	Reed	1,004
Will	Wesley	1,633
Will	Wilton	1,941
Winnebago	Winnebago	2,029
Total for 1912		76,518

TABLE NO. 8.

Stone Shipped from Joliet Penitentiary for Experimental Road Work.

1910.

County.	Township.	Cubic yards of stone.
Bureau	Walnut	2,331
Cass	Road District No. 3	2,618
Ford	Patton	2,187
Iroquois	Beaver	3,203
Kankakee	Yellowhead	1,985
LaSalle	Earl	2,351
Lee	China	1,815
McDonough	Mound	2,006
McLean	Arrowsmith	2,249
Peoria	Hollis	5,745
Peoria	Richwood	2,290
Peoria	..do	181
Sangamon	Springfield	2,200
Whiteside	Mt. Pleasant	3,572
Total		34,733

Stone Shipped from Menard Penitentiary for Experimental Road Work.

1910.

County.	Township.	Cubic yards of stone.
Crawford	Oblong	3,006
Effingham	Douglas	532
Effingham	..do	1,114
Gallatin	Shawnee	271
Jersey	Jersey	1,196
Lawrence	Bridgeport	1,827
Madison	Collinsville	4,085
Madison	Edwardsville	1,848
Madison	Helvetia	3,015
Madison	Nameoki	2,455
Marion	Salem	1,407
St. Clair	O'Fallon	4,425
Total		25,181

TABLE NO. 9.

Stone Shipped from Joliet Penitentiary for Experimental Road Work.

1911.

County.	Township.	Cubic yards of stone.
Bureau	Walnut	52
Cass	Road District No. 3	2,684
Cook	Rich	176
DeKalb	DeKalb	2,316
Ford	Drummer	2,673
Greene	Whitehall	293
Iroquois	Beaver	1,271
Iroquois	Crescent City	3,320
Kankakee	Ganeer-Momence	4,419
Lee	China	1,217
Livingston	Dwight	529
McLean	Arrowsmith	30
McLean	Bloomington	3,873
McLean	..do	1,167
McLean	Blue Mound	3,220
Peoria	Richwoods	79
Tazewell	Pekin	1,386
Whiteside	Mt. Pleasant	5,260
Will	Monee	1,944
Total		36,183

Stone Shipped from Menard Penitentiary for Experimental Road Work.

1911.

County.	Township.	Cubic yards of stone.
Crawford	Oblong	1,030
Crawford	Robinson	1,169
Greene	Whitehall	3,640
Gallatin	Bowlesville	1,314
Jersey	Jersey	64
Lawrence	Bridgeport	7,625
Madison	Collinsville	2,910
Madison	Edwardsville	796
St. Clair	Lebanon	3,619
St. Clair	O'Fallon	1,558
Total		23,725

TABLE NO. 10.

Stone Shipped from Joliet Penitentiary for Experimental Road Work.

1912.

County.	Township.	Cubic yards of stone.
Cook	Northfield	1,849
DeKalb	Malta	4,082
Ford	Drummer	3,760
Ford	Sullivant	2,392
Henry	Geneseo	2,703
Iroquois	Middleport	2,674
Kankakee	Ganeer-Momence	1,537
Livingston	Indian Grove	2,256
Logan	East Lincoln	898
McDonough	Bushnell	217
McLean	Bloomington	2,973
McLean	Dale	2,703
McLean	Mt. Hope	496
Peoria	Richwood	377
Richland	Olney	287
Tazewell	Pekin	1,700
Whiteside	Mt. Pleasant	661
Total		31,565

Stone Shipped from Menard Penitentiary for Experimental Road Work.

1912.

County.	Township.	Cubic yards of stone.
Alexander	Road District No. 7	5,231
Coles	Mattoon	3,121
Crawford	LaMotte	2,918
Effingham	Douglas	2,573
Gallatin	Shawnee	3,469
Greene	Whitehall	3,164
Jackson	Carbondale	1,372
Jersey	Jersey	74
Lawrence	Bridgeport	445
Macoupin	Carlinville	1,072
Madison	Collinsville	3,436
Madison	Edwardsville	400
Madison	Jarvis	2,453
Madison	Venice	719
White	Carmi	906
Total		31,353

EXPERT ADVICE GIVEN DURING 1910, 1911 AND 1912.

Aside from the many calls for experimental road work and bridge plans, the Highway Commission, during the past three years, has received a number of requests from township and county officials for expert advice in regard to some specific problem. In some cases it was necessary, in order to meet the request, for the department to send an engineer to make an inspection on the ground and possibly make a detailed survey, in order to give the commissioners the information they desired.

The following table gives the number of applications for expert advice received during 1910, 1911 and 1912. During these three years plans and specifications have been prepared, aside from the experimental road work carried on, for the improvement of twenty-five miles of road, the work to be done by contract under the supervision of the township commissioners, but in accordance with the general plans and specifications furnished by this department. Most of these roads have now been completed, although a few are held for lack of funds.

This phase of the work of the commission has developed in the past three or four years and there is every indication that there will be an increasing demand made upon the department for service of this kind. The commissioners in a great many townships are beginning to appreciate the fact that in order to get satisfactory road work done by contract, it is necessary to have complete plans and specifications. It has happened in a few instances that after the contract has been let and the construction is under way, circumstances arose in the course of the construction with which the commissioners were not familiar, and they have in a number of instances called upon the department for information to enable them to handle the work to the best advantage. In a few cases the State Commission has been called in to referee disputes that have arisen between the local commissioners and the contractor, and in an instance of this sort, if the plans and specifications under which the work is being done have been furnished by the State Commission, it is possible for the engineers of the commission to be of material assistance in the interpretation of the various provisions of the contract. But many requests to settle disputes, under loosely drawn specifications, are received where it is evident the request on the part of the local officials came too late for the State Commission to be of any material assistance. The time for most advantage to be taken of the information to be had from the State engineer is before the contract is let, not afterwards.

TABLE No. 11.

Expert Advice Applications

1910.

County.	Township.	County.	Township.
Bureau	Ohio	Ogle	Rock Vale
Douglas	Sargent	Pike	Pleasant Vale
Franklin	Benton	St. Clair	Mascoutah
Hancock	Dallas & Durham	St. Clair	O'Fallon & Shiloh Valley
Hancock	St. Mary	St. Clair	O'Fallon
Henderson	Oquawka	Sangamon	Springfield
Madison	Helvetia	Vermilion	Love
Madison	Nameoki	Whiteside	Albany
Madison	Wood River		

1911.

Ford	Drummer	Lee	Wyoming
Cass	Virginia	Madison	Collinsville
Clay	Clay City	Madison	Edwardsville
Cook	Sheridan Road, Chicago	Madison	Helvetia
Edgar	Embarrass	St. Clair	Caseyville
Grundy	Highland	St. Clair	New Athens
Hancock	St. Mary	Shelby	Windsor

1912.

Adams	Honey Creek	Kankakee	Yellowhead
Bond	Central	Lawrence	Lawrence
Carroll	Wysox	Madison	Edwardsville
Clark	Westfield	Madison	Helvetia (two roads)
Clinton	Breese	Montgomery	Hillsboro
Clinton	Carlyle	Piatt	Monticello
Douglas	Bowdre	Rock Island	South Rock Island
Edgar	Embarrass	St. Clair	Caseyville
Effingham	Douglas	Sangamon	Springfield
Hancock	Carthage	White	Carmi
Henry	Geneseo	Whiteside	Lyndon

MACADAM CONSTRUCTION.

SERVICE REPORTS OF EXPERIMENTAL ROADS BUILT 1906-1912.

Frequent inspections have been made of all the experimental roads built by the State Highway Commission. The office records of these inspections consist mainly of a series of photographs taken from time to time on the different roads with explanatory comments. The reproduction of a sufficient number of photographs to give even a general idea of each road is impossible because of their number, but there has been arranged in tabular form (tables 12 and 13) information as to the condition of the various experimental roads from year to year. These are divided into two main groups: the waterbound macadam roads and bituminous macadam roads.

CONCLUSIONS ON WATERBOUND MACADAM.

In regard to waterbound macadam construction, it may be remarked in general that there has been no difficulty, if reasonable precautions are taken for proper drainage, to support this form of construction on any of the soil conditions usually encountered in the State. Wherever isolated sections of macadam roads are exposed to mud marks tracked on at the ends and from adjoining roads, a disproportionate amount of damage is done than would be on a larger mileage of road. The most serious damage to any of the macadam roads has resulted from tracking on of sticky mud, particularly the first year, before the road has become thoroughly seasoned and consolidated. The mud will pick out the binder and loosen the stone which will be carried with the mud on the wheels and deposited upon the road, which, when dry, leaves the surface very uneven. Such action will be in evidence for 100 to 300 feet from either end of the road.

It has been found, however, that if sand or gravel is placed on the earth roads adjacent to the macadam for 100 or 200 feet, that it will render the mud non-sticky and no damage is done to the macadam surface. If precautions of this nature are taken for the first and second winters, there does not seem to be much further difficulty experienced from this source, as the road in the meantime will have become thoroughly compacted and does not pick up.

Some roads have been much more affected by traffic than others, although it is a fact that the roads that have worn the best in some instances have carried the largest amount of traffic. On the roads with the lesser amount of traffic, it is usually the case that one vehicle follows the other, the majority of which have narrow tires, and all the wheels use a narrow space practically within 10 inches in width. Where traffic uses a road in this manner, a rut or depression will form within a very short time after the road is thrown open to travel, and unless this depression is removed, practically every vehicle will follow in the track thus made.

If the incipient track is filled with a bonding gravel, the team traffic will avoid it, turning first to one side and then the other, according to the direction it may be going, and eventually consolidate the surface of the road. Wherever it is possible once to distribute the traffic over the whole road, there seems but little difficulty from the formation of ruts or concentration of wear in one track. Roads, however, that carry automobile traffic even in very limited amounts are difficult to repair in this manner, as the loose gravel will be soon thrown out by the motor traffic.

It has been found that a limestone road bonded with gravel to make a gravel surface, is a very much better wearing road and will carry with less damage to the surface a very considerable amount more of motor traffic than a limestone road bonded with limestone screenings alone. It is to be noted that the damage done to a macadam road the first year is much more than during subsequent years. In general, if a small amount of gravel is distributed over the surface early in the first spring, the amount required being about one car load to the mile, and a drag is used on the road occasionally as wet weather permits, it is found that the road will pass through the next two or three seasons with little or no attention, save the occasional use of the drag during late fall and early spring.

With the majority of the roads built by the commission, however, the general impression has been that such construction is permanent in a strict sense of the word, and once a road is built, that nothing further needs to be done. Thus very few of the roads have had any proper attention, so that their condition in many instances is much poorer than would have been the case under proper and systematic maintenance. As a result, when maintenance repairs have been made, the condition of the road is such that a very considerable amount of work is necessary to restore the surface, so that when this cost is distributed over the years which the road has been in use, the cost per year is often greater than would have been the case had a small amount of work been done more frequently, and the road surface in the meantime maintained in a much higher state of preservation.

Although all the experimental work on which reports are here made were built with a steam roller, many miles of road have been built under the supervision of the Highway Commission without the use of road machinery other than the ordinary smaller tools to be found in every community. Where such work has been done with some care and

TABLE

Service report on water

Place.	Road.	1906.	1907.	1908.
Salem. Marion County. Average daily traffic— Horse drawn..159 Motor..... 16	North road. Menard stone and screenings.	Finished in July.	In good condition.	In good condition..
Springfield. Sangamon County. Average daily traffic— Horse drawn..102	Pawnee. Waterbound macadam, gravel, Joliet stone and screenings, burnt shale used for lower course.	Finished in August.	Gravel used did not prove satisfactory. Part was removed and replaced with stone in 1906 Mud tracked on north end caused stone to pull out to some extent, also on south end. Middle portion of stone, good condition.	About same condition as 1907.
McLean. McLean County.	East road. Bonded with screenings.	Finished in October.	In good condition. Slight ravelling took place and road was dragged two or three times, to scrape off mud and loose stone.	In good condition.
Greenville. Bond County. Average daily traffic— Horse drawn.. 26 Motor..... 11	South road. Menard stone and screenings.			Slightly rutted, spiked up, small amount of stone added and refinished. Cost, $0.0177 per sq. yard; cost per year, $0.0088 per sq. yard.
DeKalb. DeKalb County.	North First street road.	Built late in fall.	Slight ravelling, redressed with screenings.	Generally good.
DeKalb. DeKalb County. Average daily traffic— Horse drawn..178 Motor..... 59	Fourth street road. Joliet stone and screenings used.	Completed in midsummer.	Some sections, too large amount of screenings which pushed up with the mud and formed a wavy surface which was repaired.	In good condition.
DeKalb. DeKalb County.	First street road. Resurfacing of macadam, built by U. S. Office Public Roads, 1904, Joliet stone and screenings used.		Completed.	In good condition.
Effingham. Effingham County.	Effingham-Seigel road. Menard stone and screenings used; very soft stone in part of road.		Completed.	In fair condition. Some sections where stone was soft have rutted, no ravelling noted.
Elburn. Kane County. Average daily traffic— Horse drawn..168 Motor..... 4	Lily Lake road. Joliet stone and screenings used. A part surfaced with gravel containing large amount of clay.		Completed.	Some ravelling on south mile, and clay gravel pulled up stone on north end, during wet weather.

No. 12.

bound macadam roads.

1909.	1910.	1911.	1912.
In good condition.	In good condition	In good condition.	In good condition. The surface has worn uniformly and the stones are somewhat prominent, due to absence of fine material. A dressing of gravel would put the road in first class condition.
Gravel worked into holes and stone portions much better.	About same as in previous years. No ruts appeared, surface rough at ends. Some of the holes repaired with stone.	Not much change from 1910.	No great change noted. Foundation has proved sufficient. Middle portion where stone was used in fair condition.
In good condition.	In good condition.	In good condition.	In good condition. Wear has been very uniform throughout length, a depression having worn along wheel track. The depression is about 18 inches broad and 1 to 1½ inches deep.
In good condition.	In fair condition. Is becoming rutted in some places.	In fair condition. Is wearing rapidly and becoming badly rutted in some places.	Road is rutted throughout and in poor condition. Needs resurfacing.
Generally good.	Generally good.	Generally good.	General condition, good; free of ruts, surface has worn bare, needs dressing of gravel.
In good condition.	In good condition.	In fair condition.	In fair condition. Some ruts in north part and a few ravelled places. A dressing of gravel would improve surface.
Some ruts appearing at north end.	Pair of broad ruts, about 2 or 3 inches deep, for ½ of the length of the road. Surface tight and general shape good.	Not much change from 1910.	North end surfaced with bituminous compound. Remainder of road in good condition, but should be dressed with gravel to preserve surface.
In fair condition. Rutted sections now have three pairs of ruts, due to lines of traffic changing on surface.	All rutted sections spiked, reshaped with new stone and refinished. Cost per square yard, 2.2 cents; cost per square yard per year, .055 cents.	Ruts have reappeared in some parts of road. A broad shallow depression has worn along each wheel track throughout.	The road should be dressed with gravel to preserve surface. Not much change from 1911. General condition, fair.
Three-quarters of a mile on north end surfaced with tar. Remainder of road dressed with good gravel and in good condition.	Tar surfaced section has good mat surface; water bound part has good surface and in satisfactory condition.	Tar surface worn off but stone tight and surface smooth; waterbound surface in good condition, being smooth and tight.	In good condition but no detailed report received. The waterbound section appears in equally good condition with the section covered with tar.

Table No. 12—

Place.	Road.	1906.	1907.	1908.
Lincoln. Logan County. Average daily traffic— Horse drawn..136 Motor..... 7	East Lincoln road. Joliet stone and screenings. Burnt shale used for lower course.		Completed late in fall.	Some mud tracked on west end, not much from east and generally good condition.
Highland. Madison County.	Sebastopol road. Local gravel.		Construction began using local gravel which proved of poor quality and its use was discontinued. Menard stone then shipped in but work unfinished at close of year.	Road completed with Menard stone and screenings. Gravel placed, 1907, covered with 4 inch layer of stone.
Hillsboro. Montgomery County.	Hillsboro-Vandalia road. Menard stone and screenings used.		Completed late in fall.	In good condition. Much mud is carried on to the macadam by traffic from the easterly end.
McLean. McLean County. Average daily traffic— Horse drawn..129 Motor..... 9	Section 2 of East road. Joliet stone and screenings used.		Completed in fall.	In good condition. Is covered with mud but seems to be holding well under traffic.
Rock Island. Rock Island County. Average daily traffic— Horse drawn..302 Motor..... 22	Cemetery road. Joliet stone and screenings used.		Completed in fall.	Road has suffered somewhat from wash of water from side roads. Road subjected to heavy traffic from brick yards. Generally in good condition. Requires few depressions to be filled.
Sullivan. Moultrie County. Average daily traffic— Horse drawn..149 Motor..... 19	Masonic Home road. 1907, Menard stone and screenings used. 1908, Joliet stone and gravel binder.		One mile completed in fall.	One-half mile added to first section and entire road dressed with gravel.
Greenville. Bond County.	Fourth street road. Menard stone and screenings used.		Completed in midsummer.	In good condition.
Orland. Cook County. Average daily traffic— Horse drawn..123 Motor..... 5	English Settlement road. Joliet stone and screenings used.		Completed in midsummer.	
Wheaton. DuPage county.	Chicago-Batavia road. Joliet stone used. Gravel of poor quality, used for binding.			Completed in fall.

Continued.

1909.	1910.	1911.	1912.
In good condition.	In good condition.	In good condition. A depression has worn along each wheel track.	In good condition. A depression one to two inches deep has worn along each wheel track. A surface dressing of gravel is necessary to preserve surface of this road.
In good condition. One section shows slight rut. A great deal of mud is carried on to this road by traffic.	In good condition.	In good condition. Traffic holds to one track and depression of one to two inches and about one foot wide has worn at each wheel track.	In good condition. The construction of an additional mile of macadam on this road in fall of 1912, protects it from mud. Road is too narrow for traffic now using it.
In good condition.	In good condition.	In good condition.	In good condition. Macadam covered with mud but shows a depression of one to two inches along wheel track.
In good condition.	In good condition.	In good condition.	In good condition. Has a worn rut along each wheel track and is slightly uneven, due to effect of mud on surface. Should be dressed with gravel.
No repairs made by local commissioners and some small depressions have been worn much larger. In general, is wearing well under the heavy traffic.	Condition about same as in 1909.	Some repairs made to the road particularly sections used by brick yard teams.	Some sections are in good condition and others are rutted and out of shape. In general, in fair condition; traffic seems too heavy for limestone macadam.
Mud pulled on road and worked surface out of shape, at east end. Some rutted sections in first year's work.	Not much change from 1909.	Condition noted in 1909, becoming somewhat worse.	The road is badly rutted in many places and the east end is very uneven, due to the action of the mud in pulling out the surface stones. The road has been neglected and shows utter lack of attention. Its condition is rather better than could be expected, under such circumstances.
In good condition.	In good condition.	Generally in good condition.	Part of road over sandy soil. Road has been cared for and generally in good condition. Surface has been sanded which has held it intact. In good condition. Road has held in good condition. Portions show lack of fine material. Should be dressed with gravel.
Some ruts formed at west end and ravelled slightly throughout.	Continued to ravel slightly throughout. Motor traffic sweeping surface bare of fine material.	Surface rough, due to absence of fine material around large stones of surface. Being injured seriously by motor traffic.	Surface covered with a bituminous binder. Pea gravel used to dress surface. Cost, 13 cents per square yard. Large proportion of automobile traffic, which makes impossible maintenance of water bound macadam road.

Table No. 12—

Place.	Road.	1906.	1907.	1908.
Sheldon. Iroquois County.	Sheldon-Efner road. Joliet stone and screenings used.			Finished in fall.
Mendota. LaSalle County. Average daily traffic— Horse drawn..371 Motor..... 22	Washington street road. Joliet stone and screenings used.		Completed in December.	Road ravelled in summer and was necessary to rebind the surface. Joliet screenings were used, gravel advised but not available when constructed, but used for repair work.
Dwight. Livingston County.	Mazon avenue road. Joliet stone used. Bonding gravel used on surface.			Completed in fall. Showed evidence of insufficient rolling.
Highland. Madison County.	Trenton road. Menard stone and screenings used.			Constructed in fall. Showed evidence of insufficient rolling.
Danville. Vermilion County.	LeSeures land. Joliet stone and gravel dressing.			Completed early in summer.
Carmi. White County.	Cemetery and Fair grounds roads. Menard stone and screenings.			Both roads completed by fall.
Elwood. Will County.	Symerton road. Joliet stone and screenings used.			Completed in fall
Joliet. Will County.	Joliet-Lockport road. Joliet stone and screenings used.			Completed in early summer.

Continued.

1909.	1910.	1911.	1912.
In good condition.	Surface becoming bare of screenings in middle third, and slightly open between stones.	Stones becoming exposed and in need of a dressing of gravel.	General condition good but surface open and stones too prominent. Should be dressed with gravel. Very little mud is tracked on this road.
General shape fair, but binder somewhat lacking making a rough surface.	About same as 1909.	Traffic wearing wheel track smooth. Few places loosened in horse track making small depressions.	Same general condition as in 1911. The stones used in the surface of this road were somewhat larger than usual and never seemed to compact properly under the comparatively light traffic. Should be dressed with gravel.
Stone slightly open and surface bare of screenings especially in the middle third of the macadam. West 200 feet damaged by mud which pulled out the stone from surface. All of the bare places covered with screenings and rolled.	Surface open and stones prominent. West end uneven. No ruts.	Not much change from 1910.	Not much change from 1911. Should be dressed with good gravel and would then be in good condition.
Rutted in several places and pushed out of shape by traffic.	A depression formed along each wheel track and the middle one-third appears as a ridge, due to remainder pushing out.	Spiked up, reshaped with a little new stone and refinished. Cost per sq. yard, 4 cents; cost per year per square yard, 1 cent.	In good condition but should be dressed with gravel to preserve surface.
In good condition.	In good condition.	In good condition.	In good condition but somewhat bare of fine material and should be dressed with gravel.
In good condition.	A slight depression has worn along each wheel track, otherwise in good condition.	Condition noted in 1910, somewhat more pronounced.	A depression two to three inches deep and 18 inches wide has worn along each wheel track. Stones in strip between these depressions prominent and surface deficient in fine material. A redressing of surface is necessary to preserve the road.
In good condition.	Ravelled somewhat but in fair condition.	In need of surface dressing. Ravelling a good deal through entire length. Drainage obstructed in several places.	Ravelling badly. Road needs a dressing of gravel to preserve the surface and stop the ravelling. The drainage should be improved. Traffic light on this road.
In good condition.	In good condition.	In good condition.	In good condition. This road carried a large amount of traffic, much of it heavy trucking. This road is 20 feet wide and the traffic is well distributed over the whole surface which accounts for the freedom from ruts and uniform wear it has received. Has much auto traffic but the heavy traffic seems sufficient to keep the surface compact and comparatively free from bad effects of the auto traffic.

Table No. 12—

Place.	Road.	1906.	1907.	1908.
Sycamore. DeKalb County.	Claire road. Geneva road. Joliet stone and screenings used.			
Morris. Grundy County. Average daily traffic— Horse drawn..339 Motor..... 32	South Morris road (2 sections). Joliet stone and gravel dressing used.			
Galva. Henry County. Average daily traffic— Horse drawn..116 Motor..... 11	Cemetery road. Joliet stone with gravel dressing.			
Watseka. Iroquois County.	Cemetery road. Joliet stone and poor bonding gravel used.			
Jerseyville. Jersey County. Average daily traffic— Horse drawn..126 Motor..... 10	Fieldon road. Menard stone and screenings used.			
Collinsville. Madison County.	Collinsville-Troy road. Menard stone and screenings used.			
Olney. Richland County.	Walnut street road. Menard stone and screenings used.			
Harrisburg. Saline County.	Independence road.			
Morrison. Whiteside County.	Denrock road. Joliet stone and sandy loam for binder.			
Franklin Grove. Lee County.	Oregon and Amboy roads. Joliet stone and screenings used.			
Earlville. LaSalle County. Average daily traffic— Horse drawn..233 Motor..... 24	Cemetery road. Joliet stone and gravel dressing.			

Continued.

1909.	1910.	1911.	1912.
Both completed in fall.	A few slight ruts formed, otherwise in good condition.	Slight ruts in a few short sections, otherwise in good condition.	Surface somewhat bare and a few slightly rutted places, otherwise in good condition.
Completed in August.	In good condition.	In good condition. Surface somewhat deficient in fine material, making the stone prominent.	General shape of road good but surface has ravelled slightly along the middle, due to absence of bonding material. A dressing of gravel should be applied to preserve the surface.
Completed late in fall.	Slight damage to surface on parts where mud was carried on to surface. Generally in good condition.	Surface appears uneven on part in town, due to a large amount of mud which has carried on to surface. One car of gravel was placed on this road to cover bare places. Generally in good condition.	Road in good condition outside of city. In city, road is uneven and covered with mud. Should be cleaned and redressed. Portion in city totally neglected and presents great contrast with portion in township.
Completed early in summer. Slight ravelling in fall.	Slight ravelling, otherwise in good condition.	Road covered with sandy loam and in good condition.	In good condition, the sandy loam furnished the requisite binder to keep the surface from ravelling.
A part completed in fall of 1909, the remainder in 1910.	Some rutting in part completed in 1909; repaired this season. Remainder completed.	Some ruts have appeared no ravelling noted.	One and one-half mile east end surfaced with asphalt paint coat and in good condition. Remainder of road somewhat rutted in a few places but in fair condition.
Completed early in summer.	In good condition. One short section has rutted slightly.	In good condition.	In good condition. Surface somewhat bare of fine material; slight ruts in one or two places.
A part finished this year and the remainder in 1910.	In good condition. A few ruts on section first completed. Repaired this season.	In fair condition. A great deal of mud on surface.	In fair condition but somewhat rutted and out of shape. Spiked up, reshaped and refinished with gravel. When mud had been cleaned from the surface it was found that the macadam was in very fair condition. Cost, per square yard, 10 cents; cost per year per square yard, 2½ cents.
Completed in September.	Overflowed by flood water and in poor condition.	In poor condition.	In poor condition. A drainage ditch contemplated when the road was built was never put in which made proper drainage for the road impossible.
	Completed in midsummer.	In good condition. Dressed in fall with screenings from local quarry.	In good condition.
	Completed in fall.	In good condition. Slight ravelling in a few places.	In good condition.
	Completed in fall.	In good condition. Slight ravelling on west end.	In good condition.

Table No. 12—

Place.	Road.	1906.	1907.	1908.
Effingham. Effingham County.	Fayette av. road. Menard stone and screenings.			
Arrowsmith. McLean County.	North and South road. Joliet stone and gravel dressing.			
Grant Park. Kankakee County.	Sollitt road. Thornton stone and screenings.			
Grant Park. Kankakee County.	Chicago-Vincennes road. Joliet stone and screenings.			
Walnut. Bureau County.	Cemetery road. Joliet stone and sandy loam for dressing.			
Bridgeport. Lawrence County. Average daily traffic— Horse drawn..160 Motor..... 11	Bridgeport-Sumner road. Menard stone and screenings.			
Collinsville. Madison County.	Collinsville-East St. Louis road.			
Edwardsville. Madison County.	Troy and St. Louis road.			
Nameoki. Madison County.	Collinsville-St. Louis road.			
O'Fallon. St. Clair County.	Shiloh Valley road.			
Casey. Clark County.	East Washington street road. Greencastle stone and screenings used.			
Robinson. Crawford County.	Indian boundary road. Menard stone and screenings.			
DeKalb. DeKalb County.	S. Fourth street road. Sec. 2, Joliet stone and screenings.			
Edwardsville. Madison County.	Marine road. Menard stone and screenings.			
Shawneetown. Gallatin County.	Levee road. Menard stone and screenings with sand dressing.			

Continued.

1909.	1910.	1911.	1912.
	Completed in fall.	In good condition, a few ruts but not serious.	In good condition. All ruts repaired. Slightly bare of fine material.
	Completed in midsummer.	In good condition.	In good condition.
	Completed early in season.	In fair condition, some ravelling.	In fair condition but needs surface dressing of gravel
	Completed early in season.	In fair condition, some ravelling.	In fair condition but needs surface dressing of gravel.
	Completed in fall.	In good condition, some ravelling and surface dressed with screenings and sandy loam.	In good condition.
	Completed in midsummer.	In good condition but shows wear along wheel track.	In good condition but has a depression one or two inches deep and eighteen inches wide along wheel track.
	Completed in September.	In good condition, surface somewhat bare of screenings.	In good condition but needs a dressing of gravel on surface.
	Completed in fall.	In good condition but a few ruts appeared.	Road spiked, reshaped and refinished. Cost per sq. yard, 6 cents; cost per sq. yard per annum, 2 cents.
	Completed in midsummer.	In good condition.	In good condition. A slight wear depression shows along each wheel track.
	Completed in fall.	A few sections ravelled and a few ruts appeared. These were repaired and road was in good condition.	In good condition but is deficient in fine material. A few ruts appeared. Effect of auto traffic is pronounced.
		Constructed in fall.	In good condition. One or two short sections slightly rutted.
		Constructed in midsummer.	In good condition.
		Completed early in year.	In good condition.
		Completed in early fall.	Part of hill ravelled and north end rutted. Redressed at cost of 0.6 cents per square yard; cost per year per square yard, 0.2 cents.
		Construction started 1910; finished, 1911.	A few sections slightly rutted. Surface somewhat bare of dressing. In fair condition.

Table No. 12—

Place.	Road.	1906.	1907.	1908.
Crescent City. Iroquois County.	Main street road. Joliet stone and Kenneth screenings.			
Donovan. Iroquois County.	Main east road. Joliet stone and screenings.			
Bridgeport. Lawrence County.	North Main street road. Menard stone and screenings.			
Franklin Grove. Lee County.	Amboy and Oregon roads. Joliet stone and screenings.			
Collinsville. Madison County.	Sec. 2, Collinsville-St. Louis road. Menard stone and screenings.			
Morrison. Whitside County.	Morrison-Sterling road. Joliet stone and screenings from local quarry.			
Grant Park. Kankakee County.	Wilson road. Thornton stone and screenings.			

TABLE

Service report on bituminous

Place.	Road.	1908.	1909.
Springfield. Sangamon County.	Country Club. Oiled earth.	Completed in August. 12°-14°B liquid asphalt used.	Mostly in satisfactory condition. Some sections beginning to get rutted.
Bement. Piatt County.	Ivesdale road. Oiled earth.	Completed in September. 12°-14°B liquid asphalt used.	Section 2 built, using heavy liquid residuum. Section 1 slightly rutted but in fair condition.
Naperville. DuPage County.	Washington street, High street. Aurora road. Tar and oil with stone slag and gravel.	Completed in September. Tar and asphaltic oil used on slag, old gravel. New gravel and crushed stone. Binder spread by gravity distributing wagon.	All sections where oil was used bled. On sections where old gravel was used and on section where limestone was used, the bleeding was excessive, and gravel was spread to absorb excess oil. Oil and gravel sections became uneven. Tar sections all good. Unsatisfactory sections repaired in August.

Concluded.

1909.	1910.	1911.	1912.
		Work on west end was delayed until bad weather and not properly finished.	One section in village uneven on account of action of sticky mud. Remainder of road in fair condition. Entire road has suffered somewhat from action of mud but part in village is the worst.
		Construction started in 1910; finished in 1911. Part in village treated with asphalt binder.	Waterbound road in good condition but slightly rutted in a few places. Bituminous part in good condition.
		Completed in fall. In only fair condition, due to weather conditions.	A depression has worn along each wheel track and in some places there are two pairs of such depressions, two inches deep and eighteen inches wide.
		Completed late in fall.	In good condition but slight ravelling in a few places.
		Part finished in 1911; remainder in 1912.	1911 work in good condition. Remainder finished.
		Completed in fall.	In good condition.
		Finished. In fair condition. Some ravelling late in season.	Some damage on account of sticky mud. Appears to be sufficiently rolled.

No. 13.

macadam roads.

1910.	1911.	1912.	General remarks.
Road not in good condition. Covered with cinders in summer.			This method not considered worth its cost.
Both sections in fair condition but not considered satisfactory.	Not much change from 1910.	Effects of oil disappearing.	This method not considered worth its cost.
Bleeding continued to less degree than previous year. Old gravel sections becoming uneven and rutted. Tar sections ravelling slightly. New gravel and slag sections in good condition.	All old gravel sections uneven and rutted. Oil sections better than tar sections. All sections where good materials, such as slag and new gravel were used in good condition.	Not much change from 1911. Some repairs made on old gravel sections. New gravel section becoming somewhat uneven.	Sections where good gravel or slag were used with asphaltic oil are satisfactory. One tar section good, the other sections are poor

Table No. 13—

Place.	Road.	1908.	1909.
Mt. Sterling. Brown County. Average daily traffic— Horse drawn....399 Motor..... 46	West Cross street. Tar macadam.		Completed September 1st. Tar binder used. Dressed with limestone chips. Tar hand spread.
Flossmoor. Cook County.	Flossmoor road. Tar macadam.		Completed in fall. Binder spread in one and two applications. Dressed with limestone chips. Tar hand spread.
Elburn. Kane County.	Lily Lake road. Water bound macadam resurfaced with tar binder.		Completed late in fall but good results obtained. Tar hand spread.
Grant Park. Kankakee County.	Bailey Lane. Tar macadam.		Completed in fall. Tar hand spread in satisfactory manner in one application.
Dwight. Livingston County.	Mazon avenue. 2 blocks tar macadam. 2 blocks asphaltic oil. 1 block 3 inch limestone on surface and 3 blocks 2 inch limestone on surface.		Completed in early summer. Tar blocks satisfactory. Where oil was used, bleeding was excessive. One block very unsatisfactory. Binders spread from a gravity distributing wagon. Limestone chips used for surface.
Bushnell. McDonough County.	Hurst and Davis streets. Tar macadam.		Completed in fall, one, two and three course tar treatment. Limestone chips used for dressing. Surfaced with one course treatment, began to open and be hubbly within two months. Tar hand spread.
Edwardsville. Madison County.	West street. Tar macadam.		Constructed in fall. Two applications of binder. Tar, hand spread. Voids filled with limestone screenings.
East St. Louis. St. Clair County.	Tri-City. Tar macadam.		Constructed a road where traffic was so heavy as to demand a brick pavement. Tar hand spread. Two applications of limestone chips and lead mine chats used for dressing surface. Stone used of uneven hardness.

Continued.

1910.	1911.	1912.	General remarks.
Began to be slightly rough, binder and chips pulled out by sticky mud.	Rutted and ravelled slightly. Evidence of tar about gone from surface. Surface rough but no depressions.	Resurfaced with light tar and dressed with coarse sand. Cost 15 cents per sq. yd. Cost per sq. yd per annum 3.7 cents.	Evidently character of mud carried on to road proved very injurious.
Section with one course treatment ravelled. Other sections hubbly. Tar appeared dead.	Entire road resurfaced in spring. Held in good condition remainder of season. Cost 11½ cents per sq. yd. Cost per sq. yd. per annum 3.8 cents.	In only fair condition. Mat surface wearing off rapidly. Slight ravelling in places.	To preserve this road a paint coat will be required every season. ¼ to ½ gallon treatment at cost of about 8 cents per sq. yd.
Satisfactory but mat surface beginning to wear off.	Mat top about gone but surface tight and smooth.		
In good condition until fall then began to loosen and to open between the stones. Surface bare of binder.	Painted with light tar. Good condition remainder of season. Tar sprayed on road.	Began to loosen in midsummer and to ravel slightly.	Traffic produced no bad effects till fall of 1910, when heavy stone hauling began. Similar traffic in summer of 1912, caused loosening of stone and binder.
Tar blocks and one block of oil work in good condition. One block of oil treatment in very poor condition.	Tar blocks painted with light tar. One block of oil treatment resurfaced entirely with heavy asphaltic binder and dressed with coarse sand.	Tar blocks ravelling. Oil block resurfaced in 1911, ravelling and in poor condition. One block where 3 inch stone was used on surface in good condition.	Considerable mud carried on asphalt sections by traffic. Character of the mud evidently injurious to type of binder used.
All surface treated with one application of binder slightly open stone not tightly set in surface and some ravelling taking place. Two and three application treatment is in good condition.	Condition noted in 1910, becoming worse on single course treatment. On other sections, tar hard and brittle. Road in need of paint coat.	All sections built with one application of binder scarified, reshaped with some new metal and one gallon of tar treatment given. Washed gravel used to fill voids. All sections built with 2 or 3 applications of binder, painted with ¼ gallon heavy asphalt binder, covered with washed torpedo gravel.	Results showed that one application of binder wholly insufficient, especially where road is subjected to sticky mud tracked on by traffic. Mud had no apparent effect on sections with 2 and 3 application treatment. Noticed that binder had become brittle on all sections.
In satisfactory condition. Some bleeding noted.	In satisfactory condition. Some bleeding noted, was not sufficient to make sanding necessary.	A few depressions developed this year which should be repaired. Surface otherwise generally in good condition.	This road has no mud carried on to it. Carries considerable heavy hauling from brick yards. Next season whole surface should have ½ to ¾ gallon treatment of binder and be covered with torpedo gravel.
Road getting uneven, due to uneven spreading of tar. Wearing rapidly particularly where softer pieces of stone were at the surface.	Road very uneven and rutted in places. Stone crushed under weight of traffic.	Part of road resurfaced with 3 inches of limestone and a 2 gallon asphaltic binder treatment. Gravel used to fill voids. See detailed description in chapter on experimental roads.	Traffic too heavy for this type of construction and character of stone used. Work of value for purposes of comparison. Road work in good condition at end of 1912.

Table No. 13—

Place.	Road.	1908.	1909.
Beardstown. Cass County.	Virginia road. Asphaltic binder.		
Paxton. Ford County.	Pell street and others. Tar macadam. Pell street, 3 inch stone used on surface, on all others, 2 inch stone used on surface.		
New Philadelphia. Cass County.	Main street. Tar macadam.		
Peoria. Peoria County.	Prospect Heights. Asphalt macadam.		
Pekin. Tazewell County.	West bluff. Tar macadam		
O'Fallon. St. Clair County. Average daily traffic— Horse drawn.... 71 Motor..... 28	O'Fallon-Shiloh Valley. Asphaltic macadam.		
State Fair grounds. Sangamon County.	Section 1.		
	Section 2.		
	Section 3.		
	Section 4.		
	Section 5.		
	Section 6.		

Continued.

1910.	1911.	1912.	General remarks.
Constructed in midsummer. Asphalt applied from hand spreading cans, distribution uneven and binder not hot enough. Voids filled with limestone chips. Sandy sub-soil well drained.	Surface uneven due to method of applying binder. Repaired by scraping and painting with asphalt. Work not well done and not much improvement.	Texture and stability of surface excellent. Uneven as noted before.	Believed to be satisfactory form of road for traffic encountered, if binder is spread properly.
Constructed in spring. Tar spread from nozzle under pressure. Two applications of tar used. Voids filled with limestone chips.	Satisfactory surface mat showing signs of wear.	Mostly satisfactory but some blocks need painting to preserve surface. A few spots show incipient ravelling	Road is evidently satisfactory for class and amount of traffic using it.
Constructed in fall. One and two applications of tar binder. Tar spread from nozzle under pressure. Voids filled with limestone chips.	Traffic light and no serious results noted. Surface slightly rough due to effect of sticky mud tracked on to the road.	Not much change noted from 1911.	Road is evidently satisfactory for class and amount of traffic using it.
Constructed in midsummer. Binder spread by hand spreading cans. Foundation poor and binder uneven on surface due to its being spread too cold and to method of spreading. Limestone chips used to fill voids.	Many depressions, ruts and rough places. Surface very uneven. Texture of surface excellent.	Surface scarified, reshaped with some new metal and asphaltic binder, one gallon per square yard. Voids filled with washed gravel. Under drainage provided.	Holes and depressions caused by lack of underdrainage which local officials would not provide. Wavy condition of surface due to uneven spreading of binder.
Constructed in midsummer. Two applications tar treatment. Roadbed soft and surface not in first class condition for binder. Tar spread under pressure from nozzle.	Road in fair condition but a few bad depressions and ruts appeared. Texture of surface good and binder in good condition.	Road reshaped where needed and entire surface painted with a light tar. ½ gallon per square yard. Old binder in good condition and many sections where tar was well spread is in good condition.	The surface on certain sections of this road was markedly superior to many other tar roads, due chiefly, to better quality of tar binder here used.
Constructed in fall. Limestone chips used to fill voids. Binder hand spread from cans. Two spreadings of binder.	In good condition. Slight bleeding on one section. No ruts or depressions to be seen	In good condition. No ruts or depressions to be seen.	Comparatively little mud carried on to this road. To preserve the surface in its present good condition, it would probably be well to paint with asphalt and dress with coarse sand next season.
Constructed in midsummer.	In good condition, good mat surface.	Slight impairment of mat surface due to mud carried on. Otherwise good.	Three coat treatment.
Constructed in midsummer.	In fair condition but slight deterioration from 1910.	Evidence of glutrin, very slight.	
Constructed in midsummer.	In good condition.	In good condition.	One coat treatment.
Constructed in midsummer.	In good condition.	In good condition.	One coat treatment.
Constructed in midsummer.	In good condition.	In good condition.	One coat treatment.
Constructed in midsummer.	In good condition.	In good condition.	Two course treatment shows better than one course treatment.

Table No. 13—

Place.	Road.	1908.	1909.
State Fair grounds.	Section 7.		
	Section 8.		
	Section 9.		
Beardstown. Cass County. Average daily traffic— Horse drawn....116 Motor..... 15	Chandlerville. Asphalt macadam.		
Oblong. Crawford County.	Range street road. Asphalt macadam.		
Crescent City. Iroquois County	Main street. Asphalt macadam.		
Lebanon. St. Clair County	Belleville street. Asphalt macadam.		
Lebanon. St. Clair County.	Alton-Summerfield streets Asphalt macadam.		
Morrison. Whiteside County.	Grove street.		
Momence. Kankakee County.	Range street. North part, asphalt macadam; south part, tar macadam.		
Gibson City. Ford County.	Church street road. Asphalt macadam.		

Continued.

1910.	1911.	1912.	General remarks.
Constructed in midsummer.	Fairly good.	No binding value apparent.	
Constructed in midsummer.	Slight deterioration of surface mat.	Surface mat entirely gone. Slight ravelling.	One course treatment Considerable mud carried on this section.
Constructed in midsummer.	Slight deterioration of surface mat.	Surface mat about gone. Slight ravelling.	
	Constructed early in summer. Binder applied with steam spray. Torpedo sand used for dressing. Two spreadings of binder.	Very good condition. Mat surface seems intact.	Type of road seems satisfactory for sandy soil with moderate traffic.
	Constructed in midsummer. Asphalt hand poured. Voids filled with coarse limestone screenings.	Satisfactory condition. A light paint coat would improve texture of surface.	Type of road seems satisfactory for kind of soil and amount of traffic encountered.
	Constructed late in fall. Asphalt applied with steam spray. Limestone chips used to fill voids.	In good condition. A slight impairment of mat surface noted.	Type of road seems satisfactory for kind of soil and traffic encountered.
	Constructed early in summer. Binder applied with steam spray. Limestone screenings used to fill voids.	Mat top granular and not adhesive. At edges where there is little traffic, stone not held in surface by binder.	Advisable to paint surface with good adhesive binder, next season. Some mud tracked on west end.
	Constructed early in summer. Asphalt applied with steam spray. Binder became somewhat brittle, in late fall. Limestone screenings used to fill voids.	Signs of brittleness; disappeared when warm weather came and surface is in good condition.	This was a two coat construction. A third coat would have been of advantage.
	Started in fall of 1911 and finished in spring of 1912. One section ravelled on account of brittle binder. Shortly after opened to traffic. Remainder in good condition. Binder applied by steam spray. Sand used for surface dressing.	In good condition, but surface would have been improved by a light paint coat of asphalt.	Several binders used and only one gave trouble. Believe work would have been improved if three coats of binder had been used instead of two.
	Construction started in fall and completed in spring of 1912. Tar binder applied when weather was too cold. Two coats of binder applied with steam spray. Sand used for dressing on surface. Tar section ravelled within a month after opened to traffic.	Tar section dressed with tar and sand. Asphalt sections completed. Two applications of binder applied with steam spray. Northerly section in good condition. Southerly section not satisfactory.	Poor behavior of tar, believed to be due, principally to time of year applied.
		Completed in August. Asphalt applied by steam spray. Gravel dressing used. Three applications of binder	Road in good condition at close of year.

Table No. 13—

Place.	Road.	1908.	1909.
Mattoon. Coles County.	Western avenue. Asphalt macadam.		
Pekin. Tazewell County.	Cemetery road. Asphalt macadam.		
Bloomington. McLean County. Average daily traffic— Horse drawn....100 Motor..... 44	South Morris avenue road. Asphalt macadam.		
Cairo. Alexander County.	Cairo-Mound City road. Tar macadam.		
Whitehall. Greene County.	Bridgeport street road. Asphalt macadam.		
Whitehall. Greene County.	Cemetery road.		

Concluded.

1910.	1911.	1912.	General remarks
		Completed in July. Asphalt applied with steam spray. Gravel dressing used. Two and three applications of binder.	Road in good condition at close of year. Portions with three applications somewhat better than where two applications were made.
		Completed in July. Asphalt applied with steam spray. Limestone chips used to fill voids. Torpedo gravel dressing used. Two applications of binder.	Road in good condition at end of year.
	Station 40 to station 99 constructed this year. Binder applied with steam spray. Limestone chips used to fill voids. Two applications of binder. Surface, on all but 200 feet ravelled badly, late in fall.	Station 40 to station 99, painted and dressed with torpedo gravel. Remainder of road constructed. Binder applied with steam spray. Three applications of binder. Washed gravel used to fill voids and dress surface.	Failure of first section of this road attributed to poor binder. 1912 work in good condition at end of year.
		Constructed in fall. Binder applied with steam spray. Two applications of binder. Limestone chips used to fill voids. Coarse sand used for dressing.	Road in good condition at end of year.
	Station 0 to 45 built in fall. Binder applied with steam spray. Two applications. Limestone chips used to fill voids. Entire road ravelled, first cold weather, apparently on account of brittle binder.	Station 0 to 45 painted and dressed with torpedo gravel and remainder of road finished in fall. Gravel used to fill voids and dress surface. Binder applied with steam spray in two and three applications.	Road in good condition at end of year.
		Completed late in fall. Binder sprayed on with steam jet. Two applications of binder. Gravel used to fill voids and dress surface.	Road in good condition at end of year.

McLean road, Mt. Hope Township, McLean County. Waterbound macadam, 12 feet wide. Built, 1906. Photographed, 1912.

attention given the road, especially during the first year of its life, very serviceable roads have resulted at a very reasonable cost. Such a method of construction, however, is not to be advised upon a road carrying any very considerable amount of traffic, as the inconvenience caused thereby would be far more than the cost of rolling the road and putting it in condition for travel in the beginning.

In general, it may be said that waterbound macadam construction, particularly where gravel is used for the surface dressing, is a practical form of road construction for many miles of moderately traveled roads in the State; roads that carry a sufficient amount of traffic to make their improvement in this manner worth while, at the same time have not developed an amount of motor traffic to prevent the maintenance of this form of construction at a reasonable cost. This applies particularly on those roads which eventually would become feeders to main roads where it is believed that this form of construction will prove serviceable for many years to come. But waterbound macadam is not advised on roads carrying a considerable amount of motor traffic or roads which will eventually become the main roads of a county or State system.

BITUMINOUS MACADAM CONSTRUCTION.

During the years of 1908 and 1909 a number of roads were constructed upon which bituminous compounds of various kinds were used. These roads were of an experimental nature, and were for the most part tar treated macadam. The experiments with bituminous compounds were continued during the years of 1910, 1911 and 1912, and since a number of tar treated roads were already under observation, it was decided to use asphaltic compounds very largely on the new series of experiments.

Description of Apparatus.

An attempt was made in 1910 to apply heavy asphaltic compounds with the apparatus and in the manner followed in applying heavy tars. The heavy asphaltic binders were purchased in tank car lots, heated by means of steam coils in the cars, delivered on the road in tank wagons, and distributed by hand from spreading cans. This method was entirely unsatisfactory for a number of reasons. It was difficult to get the compounds hot enough in the cars to transfer to tank wagons, and the expense of heating was large on account of the length of time steam was required to be on the cars before the compounds would be hot enough to flow readily. A temperature of 225 to 250 degrees Fahrenheit was the most that could be reached and this was entirely too low for spreading compounds of the consistency used. When spread on the road they were not sufficiently fluid to flow into the interstices between the stone, and where the spreaders would overlap in distributing the binder, a hump was formed. These places "bleed" excessively in hot weather and it was necessary to cover repeatedly with stone chips. This resulted in a very uneven surface and one very difficult to smooth after-

wards. Later the method was modified by introducing a superheater in the steam line leading to the coils in the car and by this means the binders were heated to a temperature from 300 to 325 degrees Fahren-

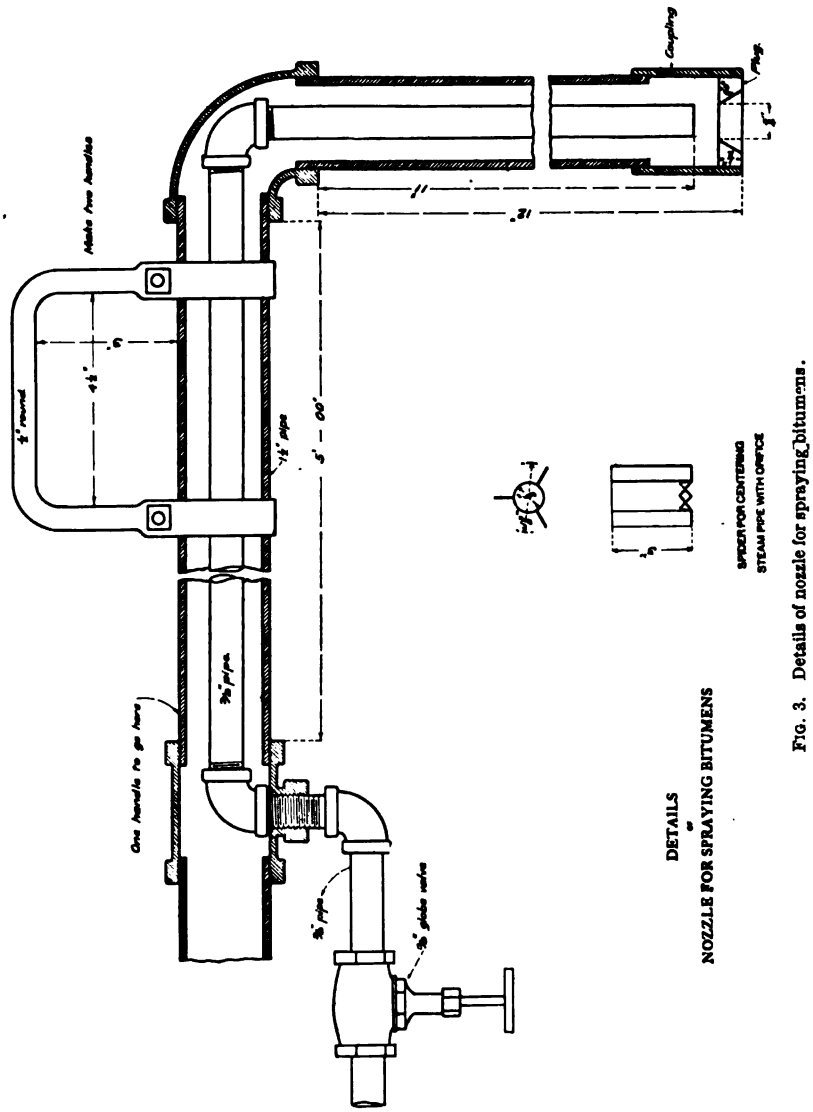


FIG. 3. Details of nozzle for spraying bitumens.

heit in the tank car. The material was then forced into a heater wagon and the temperature raised to 400 degrees Fahrenheit, which was sufficient for application.

When material is bought in tank car lots there are certain practical considerations which govern the method of carrying on the work. A tank car can not be retained on a siding for any considerable length of time. There must, therefore, be enough macadam ready for the binder to make it possible to carry on the application continuously until the tank car is empty, and at a rate which will empty a car of 8,000 or 10,000 gallons in three or four days. On resurfacing work this would be practical, but on the construction of new roads it is undesirable to have so large an amount of the road surface ready and waiting for the binder. On country road work, there are times when the traffic can not be kept off such a road, and a large amount of the work which has been done in shaping and rolling the surface of the macadam has to be done over. Inclement weather may interfere materially with the application of the binder when it is received, making it necessary to hold tank cars longer than it is desirable, or heavy rains may wet the foundation under the unfinished road so thoroughly as to delay the rolling very seriously.

It is desirable on new construction work to have as little unfinished road as possible open at a time. This means that every few days the road which is ready will be covered with binder and that a supply of the material must be on hand for that purpose. For these reasons the method finally adopted by the commission is to purchase binders in tin drums or in barrels, and to distribute the same alongside the road ready for use and to apply it as fast as the macadam can be prepared.

The methods used for applying the bituminous compound must be such as to permit the use of varying quantities of the compound to the surface. These variations may be but slight, but will be very important. The method of application should also permit variation in the amount of binder used as the necessities of the construction require.

The apparatus which is in use by the State Highway Commission was designed to meet such requirements. The asphalt is put on the road in a fine spray from a nozzle which can be carried by one man, and which will permit the operator to put either large or small quantities on any particular section of the road as desired. The nozzle is L shaped, made from pipe. Fig. 3 shows very clearly its construction. The binder is forced out of the tank wagon by air pressure through a 1¼-inch flexible metal hose to which the nozzle is connected. Steam is conducted from the steam roller through a steam hose and pipe to the nozzle. The arrangement of the apparatus is such that as the binder is forced through the orifice in the nozzle, a jet of steam blows into the binder, breaking it into a fine spray as it leaves the nozzle.

The tank itself is a steel shell designed to withstand an internal pressure of 100 pounds per square inch, and is equipped with a furnace which will burn either wood, coal or coke for heating the material in the tank. The tank has a trap door of sufficient size to permit the introduction of large pieces of solid bitumen, but so arranged that the cover can be closed air tight. A thermometer is provided at the rear. Near the front of the tank is a small dome which has an air connection and a pressure gauge. The air pipe is attached by means

Collinsville-East St. Louis road, Collinsville Township, Madison County. Constructed, 1910; photographed, December 1912. Waterbound macadam, concrete gutters
See plate No. 17.

of a flexible hose to a Westinghouse air compressor on the rear of the roller. Steam for operating the spray is piped from the steam roller through connections permanently attached to the tank wagon to the spraying apparatus and the piping is so arranged as to permit the use of the steam for warming or cleaning the discharge hose and nozzle preparatory to starting the spray. Plates 4 and 5 show the general arrangement of the apparatus. By its use light road oils or heavy solid bitumens may be applied in any quantity desired.

On much work done by the commission, solid bitumens are being used which require considerable time to heat, and in order to increase the capacity of the outfit, there is provided with each pressure tank an auxiliary kettle having a capacity of about 500 gallons. The auxiliary kettle is filled and heated while the pressure tank is being emptied on the road. The pressure tank is then drawn alongside the auxiliary kettle and partially exhausted of air by means of the air pump. Thus, the connections being reversed so as to pump air from the tank, the contents of the kettle are transferred to the pressure wagon.

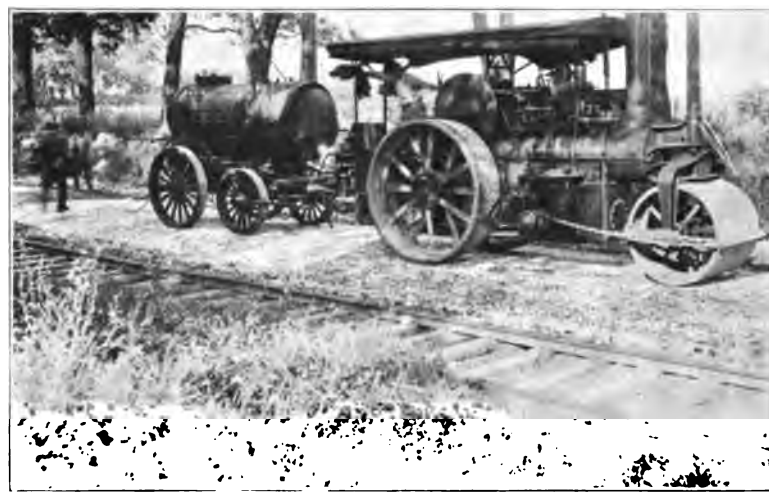
Each outfit on this work consists of a steam roller and a sprinkling wagon, an asphalt heater wagon, with complete spray apparatus, including a Westinghouse air pump which is connected to the rear of the steam roller, an auxiliary heating kettle, and an asphalt cutter, together with such small tools as are necessary.

Methods of Construction.

In addition to the modifications made in the method of applying the bituminous compounds, it has been necessary to modify previous methods of construction by discontinuing the use of limestone chips in the bituminous surface on account of the dust. Two sizes of gravel are used instead, one ranging in size from 3/8 inch to 1/8 inch, the other from 3/4 inch to 3/8 inch. Besides eliminating the trouble with dust, the gravel adds greatly to the wear resisting qualities of the bituminous surface.

As with any ordinary macadam construction, it is of prime importance that the road bed be properly prepared both as to drainage and compactness, yet, fundamental as are those requirements and as supposedly well understood, no small number of the failures seen today can be attributed to lack of attention to these important features of the construction. If the road bed has been properly drained and compacted, there will not be required a greater thickness of completed pavement than 7 to 8 eight inches. The material should be put on in two layers, the first layer forming the base on which the wearing layer is to be placed.

The method of placing the base usually does not vary, whatever may be the type of construction used for the top layer. It is essential that this base layer be compact and true to shape, and this can not be accomplished unless the stone is well spread, thoroughly harrowed and



A. Bituminous macadam construction, showing heater wagon drawn by roller.

B. Spreading heavy asphalts by means of air pressure and steam spray combined.

rolled, and then well bonded with stone dust or gravel in the same manner and with as much thoroughness as though the road were to be left with an ordinary waterbound surface.

The size of the pieces of stone in the different layers is a matter for some consideration. It has been the practice of the Illinois Highway Commission to use stone varying from 1 inch to 2½ inches in size. As practically all of the stone available for road work in Illinois is limestone, there is required a somewhat larger sized material for surface work than is demanded with a harder variety of stone. Also, it has been found convenient to use but one size of stone in both layers of the road, so that the screens at the State crushers are provided with 1-inch holes and 2½-inch holes, and no intermediate size. A dust screen with ⅜-inch holes is used to prepare stone chips from the 1-inch material.

The depth to which the stone is to be spread for the base depends upon the thickness the base is to be after it has been rolled. If the total thickness of the pavement is to be 8 inches, the wearing surface is not usually made less than 2½ inches in thickness, leaving 5½ inches for the thickness of the lower course. If the material for the top course is composed of 2½-inch sized pieces, it is recommended that this layer be made 3 inches thick, leaving 5 inches for the thickness of the base. A layer of stone about 6 inches thick, measured loose, will roll to 5 inches, possibly a little less, depending somewhat upon the nature of the material.

After the stone has been spread to the required thickness, which should be done with great care, so that there will not be more in one spot than in another, it should also be thoroughly harrowed with a coarse tooth harrow. The effect of this is to shake the various sized pieces of stone into place, and, as is well known, a box of loose stone can be compacted no better than by shaking them, so, too, we find that the loose stone in the road is compacted by shaking or harrowing which allows the smaller pieces to take their natural position at the bottom of the layer and the larger near the top. It will be found, moreover, that harrowing the material in this way will permit the roller to compact the material without the creeping that is often observed, and with one-half as much rolling.

The lower course should not be covered with screenings until it has been thoroughly compacted and each piece of rock keyed tightly in place so that when a wagon load of screenings is driven upon it the wheels will disturb the rolled stone scarcely any, if at all, and leave no decided rut or track. The screenings should be spread evenly over the whole surface and slightly watered. If the foundation is clay and wet weather has prevailed, the greatest care must be taken in watering the screenings of the first course before the road is tightened, otherwise the surplus water will soften the foundation, which must be dry before further progress can be made. After the screenings have been slightly washed or worked into the stone, more should be spread and again watered and then rolled to tighten the surface, more water and screenings being added until the surface of the base, or lower layer, is water-

A. Bituminous macadam construction. Showing arrangement of air pump on rear of roller to furnish air pressure for spreading wagon.

B. Filling spreader wagon from auxiliary heating kettle. Asphalt is drawn into spreading wagon by partial vacuum created by reversal of air pump.

tight. Screenings should not be applied so as to separate the pieces of rock which have already been keyed, but merely to fill the voids in the compacted stone with as little disturbance as possible.

The amount of crown that the finished road is to have will decide the amount of crown that the earth road bed and the base should have. In general, ½-inch per foot is not enough for the average country road with a bituminous macadam top, nor is it practical to exceed ¾ of an inch per foot. On roads to 16 feet in width, not less than ¾-inch. per foot is advisable. On roads 20 feet in width or wider, indicating that there is a large amount of traffic spread more or less evenly over the whole road, the crown can be somewhat less than on the narrower roads, but it should never be less than ½ inch. On the wider roads, a good practice is to increase the crown somewhat towards the gutter, perhaps starting on ¾ of an inch and gradually flattening towards the center, which would be effected by a curved cross-section.

On narrow roads, 12 to 15 feet in width, it is necessary to give special attention to consolidating at least 3 or 4 feet of the earth shoulder on either side of the road to hold the stone in place. As can readily be appreciated, when the roller is near the center of the road, there is a tendency to push the stone sidewise, and if there is nothing to resist this movement the stone becomes more and more open as the roller proceeds and the pieces of rock do not tighten. On wider roads, there is not so much difficulty from this cause, as a small amount of rolling towards the edge of the stone at first will place it sufficiently solid to resist any further movement of the stone at the center, for which reason it is very much easier to get a well shaped, well compacted road that is 18 feet or wider, than one but 12 feet wide. We now come to a discussion of the bituminous surface proper.

As is well known, the stability or strength of a macadam road surface to resist the action of traffic depends entirely on the mechanical locking together of the pieces of stone making up the road surface, and until this is accomplished the road surface has no cohesion. The more perfect this keying or locking together of the pieces of the stone, the more rigidity, therefore, the object of any binder, whether of stone dust or of bituminous character, is to hold the pieces of stone firmly in position after they have become well keyed and locked together. In many pieces of road that have been constructed, and in some forms of construction that have been proposed, this essential principle of the macadam construction seems to have been ignored; as, for example, in the type of road employing some form of bituminous binder in which the pieces of stone of the wearing surface do not come in contact at all, but are held apart by the bituminous material, which here acts as a matrix, forming in reality a bituminous concrete, similar to ordinary concrete, in which the matrix of cement mortar is replaced with a matrix of bituminous material. If, therefore, the matrix is not in itself sufficiently strong and rigid to withstand the pressure of traffic, such a road is doomed to failure, particularly if submitted to the traffic conditions on most country roads where the traffic tends to keep to a more or less narrow strip of the road, bringing undue pressure thereon. The

A. Macadam construction. Shows side drains through shoulders. Ditch not shaped.

B. Bituminous macadam construction. Template used for shading roadbed and spreading stone Sandy soil made side forms necessary.

fact that some of the roads built with a bituminous matrix have proven fairly satisfactory is chiefly because the traffic conditions, under which they are used, so rolls and works the road that one portion receives about as much pressure as another, and if there is a slight tendency to give at one time at one point, subsequent traffic will tend to roll out the unevenness that has been formed. Roads of this character, although giving fair satisfaction with the conditions under which they are used, would last but a short time under country road traffic. Thus, it would appear that if bituminous macadam is to be successful it is necessary in its construction to follow what has been learned by long experience, and that is to have the macadam itself firmly locked and keyed together and the stability of the road thereby assured before any binder has been applied.

The next step, therefore, after the base course has been prepared, as has already been described, is to spread the stone for the wearing layer, The stone for this layer, if limestone, should be composed of pieces 2½ inches in size and graded from this downward. If a 3-inch layer is to be made when consolidated, which is as thick as this layer need be, the stone should be spread to a thickness of 3½ inches and thoroughly raked or harrowed so as to bring the larger pieces to the surface in order that the surface may be composed in the first instance of as nearly uniform sized material and to give as great compactness as possible after it is rolled. As soon as spread uniformly and harrowed, the surface is to be rolled until it is thoroughly tightened. It may be found that there will be places where the stones do not lock together firmly; on such places a small amount of stone should be spread, just sufficient to fill the interstices, and then rolled. The effect of this rolling is to force the pieces of stone into the interstices, thus keying the whole surface until tight. It is important that great care be taken in rolling this upper layer that it be thoroughly tightened. When this has been accomplished, there will still remain interstices of appreciable size which should be filled with stone chips. These chips should be preferably of some harder material than limestone, and it is often possible to secure screened gravel that will prove excellent for this purpose. The size of the chips should vary from ¾ inch to ⅜ inch, and they should be spread over the surface of the upper course just sufficient to fill the interstices.

A good method to insure this being done is first to shovel the chips on by hand, throwing each shovelful so as to cover as much area as possible; then follow with hand brooms, sweeping ahead the surplus pieces and allowing all the interstices to become thoroughly filled. When this is done, the road is ready for the bituminous binder, as no rolling should be attempted after the chips have been spread and before the binder is applied. If the chips are rolled before the binder is applied, the effect would be merely to allow them to set in between the stones which have already been and tend to loosen the surface rather than tighten it, so it is important that after the surface has been thoroughly keyed and the chips spread, no rolling be done until after the bituminous binder has been applied.

The amount of the binder to be applied should be as little as is necessary to secure a thorough coating for all the exposed surfaces of the stone. This usually requires from ¾ of a gallon to 1 gallon per square yard. When this treatment has been applied, the surface should again be treated with the stone chips or screened gravel so as to make practically one layer of the chips evenly distributed over the entire surface of the road. This gravel had better be applied as soon as possible after the binder has been spread, if practicable following immediately behind the spreader. It may be spread somewhat in excess and swept ahead with a broom. It is important that the gravel be clean and have as little dust adhering to it as possible.

After the gravel has been spread the second time more binder is applied, which should be sufficient thoroughly to cover all of the gravel. This usually requires ½ to ¾ of a gallon per square yard. Coarse sand, if available, should then be spread upon the road, or finely screened gravel may be used. After the surface has been covered with the fine gravel grading from ⅜ inch to ⅛ inch, a seal coat of binder, using ½ gallon per square yard, is applied. The surface is then covered with the fine gravel and rolled. The roller should be provided with pipes with small orifices an inch or two apart so as to keep the wheels of the roller wet while rolling. If this is done, there will be no difficulty whatever with the binder sticking to the roller wheels. The rolling should continue until the surface is seen to be well set and compacted. It will then perhaps be found that there are some spots needing further treatment to bring them to a uniform appearance with the remainder of the road, in which case, if there be any dust, it should be swept away, fine gravel and binder applied and the whole rolled to give a uniform surface. It is probable that quite as good or better results can be obtained, after the road has been sanded and rolled, to throw it open and let the traffic develop any places in the road that need further attention.

This form of construction, it will be seen, gives a road which has the strength and rigidity of the ordinary macadam, with a water-tight covering of bituminous compound holding the surface of the road intact against the action of the motor traffic or dislodgment by the mud that adheres to the wagon wheels. So long as the water-proof covering can be maintained, the road should be in perfect condition. The gravel in the surface furnishes the resistance to abrasion. This is greatly helped by the binder, if of proper quality, which will tend to keep the particles covered or imbedded as fast as they may become loosened or broken by the traffic. When in the course of time the surface has become sufficiently worn to expose the stone making up the wearing course, it can be renewed by thoroughly cleaning the road, putting on a light application of the binder and renewing the fine gravel.

CONCLUSIONS ON BITUMINOUS MACADAM.

There is presented in tabular form (table 13) a statement in detail showing the general methods of construction and the condition of each piece of bituminous macadam work that has been constructed by the

State Highway Commission. For more specific information as to methods of construction and type and characteristics of binders used, reference should be made to the succeeding pages in this chapter.

It will be noted that reference to the binder has been made by number only, these numbers referring to the laboratory number, and there will be found in the chapter on laboratory work the analysis for each binder used. This has been done in preference to making reference by trade name, for the reason that the trade name alone does not insure necessarily a definite quality of binder. Inasmuch as binders of the same trade name were used, but with varying results, in some cases good and others bad, if reference to trade names were made, only confusion would follow.

The comparatively short experience that has been had with this form of construction with the work under the supervision of the Illinois Highway Commission and elsewhere, makes it impossible to draw any final conclusions. The results, however, of the experience so far gained, seem to show, first, the necessity in this form of construction for as stable a foundation course as possible, and that probably the best method would be to lay the first course of the road as water bound macadam, applying the bituminous top about 3 inches thick the following season when the foundation course had become thoroughly well compacted.

Second. The necessity for using durable material in the bituminous top, and where under the conditions that exist in Illinois, limestone alone is available, the material used for filling the voids and dressing the surface of the bituminous layers as they are applied, should be of washed gravel and torpedo sand. The particles of the gravel are made up for the most part of silicious material, which is the hardest material available, but where the rock of which the road is made is tough and hard, then rock chips could be substituted.

Third. It is necessary that the bituminous binder be spread so as to present as uniform a surface as possible. This may not necessarily mean the uniform distribution of the binder as the texture of the surface of the macadam before the application of the binder may itself not be quite uniform. Therefore, the more finely divided form in which the asphalt can be applied, the better the control of its distribution. The form of the application whereby the material is spread by a jet of steam has given excellent results.

Fourth. Too much binder should not be used as it will result in a less stable layer of bituminous concrete than if sufficient binder is used only to fill the voids in the stone.

Fifth. It is essential that the surface of the road have very close texture and that usually this can not be secured in less than three applications except by an excessive amount of binder. The most economical and best results can be secured when the binder is put on in three applications.

Sixth. The bitumens which do not possess some ductility at freezing temperature have not been satisfactory.

Seventh. There is some evidence to show that certain bitumens of low ductility at ordinary temperature are seriously injured by mud that

may be tracked upon the road, particularily if the soil is of slightly alkaline character. There does not appear to be an equal amount of injury done by mud from soils of slightly acid character, though in either case the results are not as satisfactory as with bitumens possessing higher ductility. It is important that bitumens be applied at high temperatures, and if possible, during hot weather, as some unsatisfactory results obtained can be attributed to the cold weather prevailing at the time of construction. The roads constructed with tar binder under ordinary traffic conditions seem to require a paint coat at the end of the second, at the furthest, during the third season, by which time the tar near the surface of the road seems to have lost most of its adhesive qualities.

Eighth. A tar with approximately the following analysis has proved most satisfactory.

Specific Gravity. The specific gravity at 25° C shall not be more than 1.26.

Free Carbon. The free carbon shall not exceed 20 per cent by weight.

Consistency. The consistency as determined by the Howard & Morse float apparatus at a temperature of 50° C shall be not less than 1½ minutes nor more than 2½ minutes.

Distillation. Fractional distillation shall give results within the following limits, all measurements being by volume.

Up to 110° C the distillate shall not exceed 2 per cent and shall be free from ammoniacal water.

Up to 170° C there shall be not to exceed 5 per cent distillate, of which not more than one-fourth shall be naphthalene.

The total distillate up to 315° C shall be at least 18 per cent.

Brittleness. A cylindrical prism of the tar binder 1 centimeter in diameter, after being maintained at a temperature of 0° C for 20 minutes, shall bend into a semi-circle of 3 centimeters diameter without checking or breaking.

Ninth. A surface constructed with an asphalt binder apparently requires a paint coat during the third or fourth season. While the asphaltic binders do not seem to lose their adhesiveness, the mat forming the close texture of the surface under ordinary traffic conditions will have become worn so as to make the application of a paint coat desirable as a protection against further wear of the road. The most satisfactory results with asphalt binders were obtained with those having closely the following analysis:

Class A bituminous binders shall conform to the following specifications, the various properties described being determined by the methods proposed by the American Society for Testing Materials:

1. The material shall be free from water.

2. *Specific Gravity.* The specific gravity at 25° C / 25° C (77° F) shall not be less than unity.

3. *Total Bitumen.* The bituminous material shall be soluble in chemically pure carbon bisulphide at air temperature to the extent of at least ninety-nine and one-half (99.5) per cent for residuums and

gilsonite products, ninety-five (95.0) per cent for Bermudez products, eighty (80.0) per cent for Cuban products, and sixty-five (65.0) per cent for Trinidad products.

4. *Naptha Insoluble Bitumen.* Of the total bitumen not less than fifteen (15.00) nor more than twenty-eight (28.0) per cent by weight shall be insoluble in 86° B paraffine naptha at air temperature. On evaporation of the naptha solution the residue obtained shall be sticky and not merely oily.

5. *Fixed Carbon.* The fixed carbon shall be not less than eight (8.0) nor more than fourteen (14.0) per cent.

6. *Penetration.* The penetration as determined with the Dow penetration machine, using a No. 2 needle, 100 grams weight, 5 sec. time, and a temperature of 25° C (77° F) shall not be less than twelve (12.0) millimeters, nor more than sixteen (16.0) millimeters.

7. *Loss on Evaporation.* When twenty (20) grams (in a tin dish 2-⅜ inches in diameter and ¾ inch deep with vertical sides) are maintained at a temperature of 170° C (338° F) for five (5) hours in a N. Y. testing laboratory oven, the loss shall not exceed six (6.0) per cent by weight. The surface of the residue at air temperature shall be smooth and show no sign of blistering or cracking, and when tested with the Dow penetration machine for five seconds at 25° C (77° F) with a No. 2 needle, and 100 grams weight, it should have a penetration of at least five (5.0) millimeters.

8. *Ductility Test.* The ductility at 25° C (77° F) shall not exceed eighty-five (85) centimeters according to the District of Columbia standard.

9. *Flash Test.* The flash point in an open cup shall not be less than 163° C (325° F).

10. *Paraffine Scale.* The asphaltic binder shall not contain more than two (2.0) per cent by weight of paraffine scale.

Class B bituminous binders shall conform to the following specifications, the various properties described being determined by the methods proposed by the American Society for Testing Materials:

1. The bituminous material shall be free from water.

2. *Specific Gravity.* The specific gravity at 25° C / 25° C (77° F) shall not be less than 0.965 nor more than unity.

3. *Total Bitumen.* The bituminous material shall be soluble in chemically pure carbon-bisulphide to the extent of at least ninety-nine and one-half (99.5) per cent by weight at air temperature.

4. *Naphtha Insoluble Bitumen.* Of the total bitumen not less than twenty (20.0) nor more than twenty-six (26.0) per cent by weight shall be insoluble in 86° B paraffine naptha at air temperature. On evaporation of the naptha solution, the residue obtained should be sticky and not merely oily.

5. *Loss on Evaporation.* When twenty (20) grams (in a tin dish 2 ⅜ inches in diameter and ¾ inch deep, with vertical sides) are maintained at a temperature of 163° C (325° F) for five (5) hours in a N. Y. testing laboratory oven, the loss shall not exceed two (2.0) per cent by weight. The surface of the residue at air temperature shall be smooth

and shall present no greasy spots nor any sign of blistering or cracking. The penetration in the residue shall not be decreased more than forty (40.0) per cent from the original consistency.

6. *Fixed Carbon.* The fixed carbon shall not be less than seven (7.0) nor more than thirteen (13.0) per cent.

7. *Penetration.* The penetration as determined with the Dow penetration machine, using a No. 2 needle, 100 grams weight, 5 seconds time, and a temperature of 25° C (77° F) shall not be less than seven (7.0) nor more than twelve (12.0) millimeters.

8. *Paraffine Scale.* The bituminous binder shall not contain more than six (6.0) per cent by weight of paraffine scale.

9. *Carbon-Tetrachloride Insoluble Bitumen.* Of the total bitumen not more than half of one (0.5) per cent by weight shall be insoluble in chemically pure carbon-tetrachloride at air temperature.

10. *Britileness Test.* A cylindrical prism of the bituminous binder 1 centimeter in diameter, after being maintained at a temperature of 5° C for 20 minutes, shall bend in a semi-circle of three centimeters diameter without checking or breaking.

11. *Flash Test.* The flash test in open cup shall be not less than 200° C (392° F).

12. *Melting Point.* The melting point shall not be less than 60° C (140° F).

13. *Ductility.* The ductility at 25° C shall not be less than 25 millimeters, according to the District of Columbia standard.

These binders are of two general classes, and it was found in practice that excellent results were obtained by using a mixture of three parts of low price blown oil or residual asphalt of class B combined with one part of a natural asphalt of class A.

Tenth. The size of stone in the bituminous layer should range from 2½ inches to ¾ inches where limestone is used. When trap rock or other equally hard material is available, stone should not exceed 2 inches in size; the chips for filling the stone not to exceed ¾ inch and the grit for the top dressing not to exceed ¼ inch, and all of the materials to be free from dust.

Eleventh. The use of a laboratory is absolutely necessary for making tests on materials and mixtures as construction proceeds.

Twelfth. Experience indicates that this form of construction is adapted to moderate traffic roads, that is, where there is no large amount of extra heavy hauling. Where the traffic is composed of automobiles and farm loads not to exceed two tons, this form of construction will prove satisfactory, although possibly not as durable as either concrete or brick. Where traffic consists of heavier loads, wholesale trucks, heavy coal hauling and loads reaching to five and six tons, it is believed this form of construction is not at all suitable.

It presents a pleasing appearance and is well adapted to horse drawn traffic as well as automobile traffic, but requires close attention for maintenance, and there is some evidence that during warm weather when the bitumen is least stable there is a tendency for the surface to creep and undulations develop.

The cost of this form of construction over that of first class water-bound macadam is approximately 20 cents per square yard, but there has not been had sufficient experience to determine definitely the maintenance cost and its final economy. The construction requires the utmost care in every detail, and owing to the small experience contractors have had with it, appreciation of this fact has not been realized, with the result that nearly everywhere work done under contract has not been as satisfactory as that done by day labor under the immediate supervision of skilled men.

Where attention is given to the construction and where the services of a laboratory are available, to insure the character of the materials, there is no difficulty to duplicate results.

Bituminous macadam is of doubtful value on those sections of roads so situated that considerable quantities of mud will be tracked on them from adjoining roads.

COST OF MACADAM CONSTRUCTION.

At the close of the season of 1912 there were available cost data obtained from the construction of about 150 separate pieces of road, involving the handling of 286,494 cubic yards of stone. A study of these data shows that the various unit costs are constant, regardless of the distance to the road from the tracks from which stone is hauled, except the cost per cubic yard for hauling stone. The costs of the various parts of the work shown in table No. 14 are the averages of these items for all of the roads constructed.

A study of the data on the cost of hauling stone shows that this cost increases constantly and almost uniformly from a distance of one-fourth mile upwards. This variation is most readily shown by means of a curve which is given in Figure No. 4. It is possible, with these data available, to make an estimate of the cost of the construction of a mile of macadam road for any length of haul for stone not exceeding three miles. When the width of a road and the thickness of the material have been decided, the fixed items of cost in the road can be immediately determined by use of the unit costs from table 14. Then, by referring to Figure 4, the cost per cubic yard for hauling stone is determined.

In this manner the estimates of cost of one mile of road, as given in table 15 have been made up, and as noted in the table, the cost of crushed stone is assumed to be $1.25 per cubic yard f. o. b., cars at the siding from which it is to be hauled.

In bituminous macadam roads the cost of the bituminous binder is assumed to be 8 cents per gallon f. o. b., the siding from which it will be hauled, and it is also assumed that two gallons of binder per square yard of surface will be used.

This table is based on the actual cost of the work which has been done by the Illinois Highway Commission, and makes no provisions for contractors' profits. It does, however, include cost of maintenance of equipment under the item of rolling and sprinkling.

It should be noted that the allowance for shaping the road bed, and trimming shoulders and side roads, while covering the ordinary earth work necessary on the average road encountered in Illinois, would not be a large enough allowance if the road to be improved included heavy earth work to reduce grades, or construct embankments.

The cost of labor on the various pieces of work varied from 30 cents to 50 cents per hour for teams and from 15 cents to 25 cents per hour for men, and the number of pieces of work where the lower price was paid was about as large as where the higher price was paid. It would probably be fair to assume that these costs are substantially correct where teams received 40 cents per hour, and men 20 cents per hour.

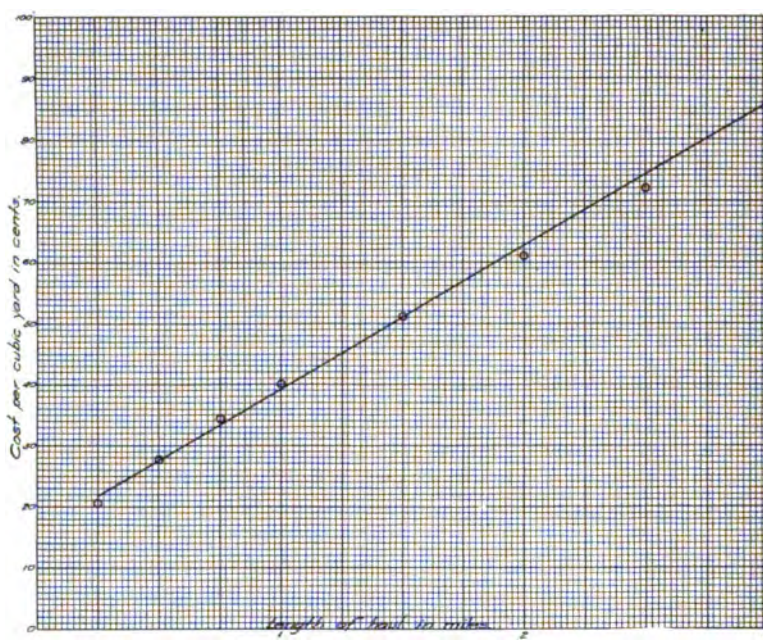


FIG. 4. Curve showing cost per cubic yard for hauling stone.

In table 15 the quantity of stone per mile is given and it will be noted that the quantity does not increase in proportion to the width. This is due to the fact that a road 12 feet wide is made of uniform thickness, while the wider roads are made somewhat thinner at the edge than at the middle. The 12 foot road is estimated on a basis of a thickness of 10 inches of loose stone, while the 16 foot road is assumed to be 10 inches thick at the middle and 8 inches thick at the edge, making the average thickness 9 inches. For roads wider than 16 feet, the average thickness has been taken as 8½ inches.

The cost of bituminous macadam roads exceeds the cost of waterbound macadam roads by the cost of the binder, plus the cost of application,

and the experience of the commission in the construction of bituminous macadam roads by the penetration method indicates that two gallons of binder per square yard of macadam is required.

TABLE NO. 14.

The following unit costs are the average from data collected from about 100 separate pieces of work involving the handling of 286,494 cubic yards of stone

Item.	Cost per sq. yd.	Cost per cu. yd.
Shaping road bed, trimming shoulders and side roads	$0.03	.....
Applying bituminous binder	0.023	.....
Superintendence, watchman, etc	0.037	$0.12
Loading stone on wagons	.....	0.107
Spreading stone	0.028	0.093
Rolling and sprinkling	0.027	0.071

TABLE NO. 15.

Estimated cost of one mile of macadam road. Based on actual cost of work done by the Illinois Highway Commission 1906-1912

NOTE—
Cost of crushed stone per cubic yard assumed at $1.25, f. o. b. cars destination.
Bituminous compounds assumed at 8 cents per gallon, f. o. b. cars destination, using an average treatment of two gallons per square yard.
These costs do not include contractor's profits.

Width—feet.	Cu. yds. stone per mile.	Sq. yds. per mile.	Average haul ½ mile.		Average haul 1 mile.		Average haul 2 miles.		Average haul 3 miles.	
			Water-bound.	Bituminous.	Water-bound.	Bituminous.	Water-bound.	Bituminous.	Water-bound.	Bituminous.
12	2,200	7,040	$4,572	$ 5,859	$4,836	$ 6,123	$5,298	$ 6,585	$ 5,870	$ 7,157
16	2,637	9,387	5,659	7,375	5,875	7,591	6,429	8,145	7,115	8,831
18	2,805	10,560	5,960	7,892	6,297	8,229	6,886	8,818	7,615	9,547
20	3,116	11,733	6,624	8,770	6,995	9,141	7,649	9,795	8,459	10,605
24	3,740	14,080	7,948	10,524	8,397	10,973	9,182	11,758	10,154	12,730

CONCRETE ROADS.

Concrete pavements present many characteristics totally unlike other forms of pavement in much more general use. A concrete pavement has a hard rigid monolithic surface and is properly to be classed a sheet pavement. Practically all other forms of rigid surface pavements are of the block type, while all other sheet pavements are somewhat resilient. The fact that concrete pavements are composed of large monolithic slabs of rather brittle material, having a coefficient of expansion due to temperature, differing not greatly from that of steel, makes it necessary to consider certain features of construction not usually important in other forms of pavement.

The fact that a concrete road is rigid results in the surface layer being subjected to far greater impact stresses than is received by a pavement of a more resilient type. The strength of concrete to resist stresses of all character depends on the strength of the matrix or mortar holding the aggregate together assuming that we have an aggregate of sound hard particles. The concrete being made of various sized particles held together by the matrix, it becomes necessary that none of these particles is loosened under the action of traffic.

EXPANSION JOINTS.

Owing to the constant movement of a concrete pavement due to temperature changes, it is impossible to prevent cracks forming. On hot days the pavement tends to lengthen, and on cold days to shorten. It is evident that the cracks form when the pavement tends to shorten.

If the formation of cracks in a haphazard way is to be prevented, it will be necessary to provide joints close enough together that there will be sufficient strength in the concrete to drag one-half its length between joints.

If expansion joints are placed from forty to fifty feet apart and on the assumption that the coefficient of friction of the pavement with the subsoil is one, the tensile strength to be exerted as the pavement shortens under low temperature will be 20 to 25 pounds per square inch. While this is not too high an allowance for the tensile strength of concrete of the type recommended for concrete roads, it is evident that whether such a stress or greater one is exerted, depends entirely upon what is the coefficient of friction. However, there is every evidence to suppose that joints may be placed even farther apart than 50 feet with entire safety.

The advantage of making the cracks beforehand is that their edges may be properly protected from traffic. It will be realized at the outset that the expansion joints constitute the weak points in the pavement, and that there should be as few of them as possible.

If a concrete pavement is laid without expansion joints it might pass the first season without any serious consequences from buckling, as the cracks that are formed by the low temperature might not become sufficiently filled with incompressible material but that they afforded some relief as the pavement expanded under subsequent temperature rise. But as time goes on the cracks will become more and more filled with grit, become more nearly incompressible, so that in no very long time they will cease to be expansive and to afford any opportunity for movement of the pavement, which movement must then be taken up by deforming the concrete; and the stresses that will be induced by such deformations are beyond what is to be expected a thin slab can withstand without buckling.

Expansion joints should not be laid at right angles with the direction of the road, for there is likely to be formed at an expansion joint a slight unevenness in the surface. If this is the case, then two wheels of a vehicle strike it at the same time and the irregularities become noticeable, whereas if the joint is placed at an angle with the direction of travel, the wheels on the opposite sides of the vehicle will pass over the unevenness, if there is any, in succession and greatly reduce its effect.

It is recommended that expansion joints be placed at an angle of 60 degrees with the center line of the road, and that successive joints be not parallel, swinging first one joint 60 degrees in one direction and the succeeding joint 60 degrees in the opposite direction, which will tend to reduce any cumulative vibrations.

In order to protect the edges of expansion joints, they may be faced with steel plates which are manufactured for this purpose, and are cut to fit the crown of the road.

MIXTURE.

One explanation to be offered for failures of concrete roads due to disintegration or raveling under traffic is probably as much a lack of mortar in the concrete as a lack of cement in the mortar. The conclusion from observation is that with a given aggregate there will be little difference between roads built in proportion of 1, 2½, 5; 1, 2, 4; or 1, 1½, 3; for in each instance, assuming that the aggregate runs precisely the same, there is but 50 per cent mortar, and where a 1, 2, 4, mixture might have given unsatisfactory results, this condtion would not be greatly bettered by using merely a richer mortar. What should be done is to increase the per cent of mortar. For example, instead of 1, 2, 4 mixture, to use 1, 2, 3½; the object to be attained, in order to secure the requisite strength, is to have the walls of matrix between the particles of aggregate of sufficient thickness to hold firmly on all sides each piece of aggregate. To be sure of this, requires an excess of mortar over the voids in the aggregate of 10 to 15 per cent. In general it is recommended that the mortar should not be less than 60 per cent of the aggregate.

The fact that the action of traffic subjects every portion of exposed surface of the pavement to severe treatment makes it necessary to have the requisite strength presented at all points. Therefore concrete for concrete roads must be more thoroughly mixed and of higher grade than is necessary in any other form of concrete construction.

Each batch of concrete as deposited in the road should be watched that the mortar does not flow to the edge of the pile and leave a core of aggregate unsupplied with sufficient mortar. At least one workman should be assigned to shovel all such cores of aggregate to the bottom of the concrete layer so as to insure only cement rich in mortar at the surface. If this is not done, depressions will develop in the surface under traffic which will loosen the clusters of pebbles of the aggregate which do not have sufficient mortar to hold them fairly in place. The men finishing the surface should be warned not to let such places go by them without shoveling out the pebble clusters and replacing them with a richer mixture. A finisher can easily cover such a place by working a film of mortar on the surface without necessarily filling the voids below.

AGGREGATE.

Attention should be given to the nature of the aggregate. None of it should be over 1 inch size particles and should include all sizes down to the sand grains. If crushed stone is at hand, the screenings should be retained in the stone unless they are of such character as cannot be well used in the place of sand. Well graded gravel forms one of the best aggregates that can be used. Only hard material absolutely sound and free of all soft particles should be in the aggregate.

AMOUNT OF CEMENT TO USE.

In all cases the amount of cement to be used must be carefully proportioned from the amount of sand. With a uniformly graded material, the amount of sand depends upon the size of particles we arbitrarily determine to be called sand, which is often taken to be all of the material passing a one-quarter inch mesh. The amount of sand being ascertained, the amount of cement is thus determined for a given volume of the gravel. Most gravel carries a high percentage of sand as compared to the aggregate.

There would thus be required in a cubic yard of concrete under these conditions, more cement than if the sand was not in excess. It will oftentimes be found economical to add screened gravel, so as to bring the sand and the aggregate more nearly to the desired proportion. It has already been pointed out that it is important to have a large proportion of mortar, not less than 60 per cent of the volume of the aggregate. For example, with proportions of 1, 3, 5; 1, 2½, 4; or 1, 3, 3½, the mortar is about 60 per cent of the aggregate in each case.

It has been pretty well established that the leaner mixtures, 1, 3, 6; 1, 3, 5, are not satisfactory in concrete pavement work. The present practice of the Illinois Highway Commission is a mixture of 1, 2, 3½.

CURING CONCRETE.

Even if a good mixture has been used, a bad pavement may result if proper care is not taken to supply an abundance of moisture while the cement hardens. Shrinkage cracks occur if the concrete has not been covered and kept thoroughly moist for a period of not less than two weeks. The usual methods to secure proper curing are first covering the concrete with canvas as soon as it has taken an initial set so that it will not be marred. The canvas is kept moist and then in a few hours, or as soon as the concrete becomes sufficiently set, sand or earth is shoveled upon it and well watered. This requires that there be an ample water supply at hand, and is one feature of concrete construction that in some localities at certain times of the year may prove somewhat awkward.

The amount of water that will be used in the mixer, as concrete highway work progresses, is from eight to twelve thousand gallons a day aside from what is necessary to keep the road moist. Therefore it is usually necessary to provide a concrete road outfit with sufficient pipe and pump capacity to furnish water along the road for one or two miles Two inch pipe will be found a convenient size unless the distance becomes so great that the frictional head reduces the capacity of a reasonable sized transportable pump so that sufficient water is not furnished at the mixer. The pump should not have less than 50 gallons per minute capacity and withstand a pressure of 150 to 200 pounds per square inch.

THICKNESS.

The thickness of concrete roads does not need to be greater than the same condition of subgrade would demand of a macadam pavement. If the subgrade is properly prepared and well drained there would seem to be little reason for a concrete road to be over 6 or 7 inches thick. It should be borne in mind, however, that owing to the monolithic and brittle character of the concrete slab, it is very necessary, perhaps even more so than with the macadam construction, to have a perfectly drained subgrade. Also as a matter of economy in construction, it is important that the subgrade be prepared carefully and truly to cross sections and grades, so that additional concrete, which is expensive, need not be employed to fill depressions and uneven places in the subgrade; but it is better that the subgrade be a trifle too low than too high in order to avoid thin places in the concrete from the latter cause.

CROWN.

The surface of a concrete road will need no more crown than is absolutely necessary to keep it free from water that may fall upon it. Aside from draining the water, the road should not be made too flat, as it will not have as pleasing an appearance as one with a somewhat curved surface. If the center is raised about $\frac{3}{8}$ of an inch to the foot above the sides and then a curve passed through this point and the sides, a very satisfactory crown is made and one that is by no means inconvenient for traffic. On roads of 30 feet or over this could be reduced somewhat, possibly as low as $\frac{1}{4}$ of an inch to the foot.

Figure 5 is a cross section for a concrete road. Attention is called in particular to the drainage that is provided under each edge of the concrete where there is cut in the subgrade a small trench filled with loose stone. From these longitudinal drains extending under either edge of the concrete, transverse blind stone drains are placed through the shoulders, usually opposite the ends of the expansion joints, and as much oftener as the nature of the soil seems to require.

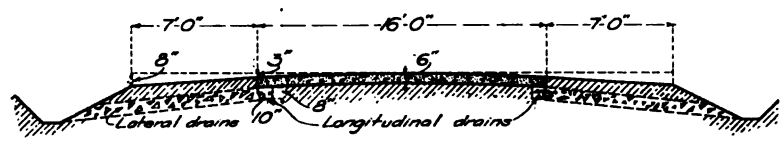


Fig. 5. Cross section for 16 foot concrete road. Note drainage system.

The object of this system of drainage is to prevent the water falling upon the road percolating under the edge of the concrete slab, which it is apt to do because of the fact that the shoulders should be kept a trifle higher than the concrete, to make it easier for a vehicle to turn from the shoulder onto the concrete. The water is therefore held at the edge and, in some instances, apparently has softened the subsoil sufficiently to cause a settlement of the concrete which is evidenced by longitudinal cracks near the center of the road. It is believed this system of drainage will in a great measure prevent the formation of such cracks in so far as they may be due to settlement of the edges of the concrete.

FINISH.

The surface of the road should not be finished smooth, but left slightly rough. This may be done by the workmen using a wood float or it may be done after the work has been floated fairly smooth by slightly marking the surface with a broom. This latter method is perhaps better adapted to rock and sand concrete than gravel concrete, as the latter will leave many small pebbles in the surface and not finish with so smooth a mortar surface as sand and rock concrete.

ORGANIZATION OF WORKING FORCE.

A good plan of organization for carrying on concrete road work is to divide the work into two parts, each under a competent foreman or superintendent; the first party to do the grading, prepare the subgrade carefully and haul the aggregate on the roadbed in such quantities that there will be sufficient to provide for the concrete. It is better, however, to have slightly less than too much aggregate in the roadway, as it is more economical to haul in an extra load or two to make up any deficiency that may occur than to dispose of a surplus.

It should be borne in mind for estimates for this part of the work that there will inevitably be a small amount of aggregate left on the

roadbed, which is by no means a bad feature, so that there should be allowed a full cubic yard of gravel or stone for each cubic yard of concrete to be laid.

The second party comes upon the work with the concrete mixer and starts in at one end of the road to mix and place the concrete. With an automatic distributing type of machine, five to seven men will be about all that can be used advantageously to shovel the material into the hopper. Two men will be required on the machine, one man to clean up as the machine advances so that the concrete may be placed on a clean roadbed; two or three men taking up the forms as used and putting them ahead; three men to strike the work, using the template and two men finishing with floats. Parties so made up, with a 12 foot capacity mixer, will lay from 500 to 800 square yards of 7 inch concrete in 10 hours; 500 square yards can be laid with a comparatively untrained crew, or a trained crew should handle 700 or 800 yards. The teams necessary for this part of the work would be only those required to haul the cement and an occasional load of gravel.

There are sections of the country where continued sultry summer weather prevails when it will be necessary to work the shovelers in two gangs, working from 15 to 20 minutes each. Either this must be done or the progress of the whole party reduced to about one-half what it is in cooler weather.

A third party might be organized to trim the shoulders and attend to final finishing of the side roads and ditches.

MAINTENANCE.

Like all other forms of road construction, if the concrete road is to give proper service it must have proper maintenance. Just what it will be necessary to do to maintain properly a concrete road cannot now be entirely foreseen owing to the limited experience with this form of construction.

Most uneven places in concrete roads are started by the formation of a crack, the edges of which will become broken down under traffic. That a crack forms shows that there has been movement of the concrete, and doubtless the cause resulting in the cracks still exists. If the cracks should become filled with incompressible material either by pouring in a thin grout or gradually filled with dust and grit from the road, there is every likelihood that the crack will extend under subsequent movement of the concrete slab.

It is believed that it is important to leave the concrete surface free to to move as it shows by the appearance of cracks that it is necessary for it to do. Therefore, as soon as cracks are formed, and a sharp lookout should be kept for them, they should be cleaned out as thoroughly as possible and filled immediately with some plastic material, such as an asphalt pitch. This will prevent water seeping through the cracks and also offers considerable protection to the edges especially if the crevice is flushed with a slight excess of the pitch.

In the maintenance of concrete roads all expansion joints should be kept carefully under observation, and as soon as there is evidence that

the plastic material has been worn away, as will happen during hot weather when it is squeezed out, it should be replaced and the cracks not allowed to become filled with hard material.

The most seasonable time to fill the expansion joints would be late in the fall before bad weather sets in when the pavement is at a low temperature and the joints extended. They should then be cleaned thoroughly and filled full of the pitch. During the summer, doubtless most of this pitch will be squeezed out and lost, so that the joints should receive late in the fall yearly attention.

The shoulders must be kept flush with the edge of the concrete, and, wherever possible, the shoulders had better be of macadam or gravel at least for a narrow strip against the edge of the concrete. Special care should be taken to see that the drainage of the road is kept in perfect condition at all times.

If a depression is caused by wearing away of the material at some point in the road wherever the cement or mortar was deficient, it will be necessary to replace this portion of the work, which can be done only by cutting away with chisels usually for the entire thickness of the pavement, and refilling with new concrete. The sides of the holes to be refilled should be as nearly vertical as possible and carefully cleaned with an acid wash, rinsed, thin neat paste applied and immediately filled with the new concrete mixed as nearly as possible of similar materials as the old concrete. Under no condition should an attempt be made to mend the surface of a concrete road with other than concrete. After a patch as described has been made,it is possible there will be formed a fine crack around the edge of the patch as the concrete sets. If this is noticed, it should be filled with pitch.

COST OF CONCRETE ROADS.

During the season of 1912 five sections of concrete road were constructed by the Commission and cost data obtained in the construction of these roads, together with data obtained in the construction of macadam roads, makes it possible to estimate with reasonable accuracy the cost of concrete road construction.

While the data obtained in the construction of these five sections of concrete road would not be adequate as regards the cost of earth work and the hauling of materials, it is conclusive as regards the kinds of work which are distinctive of the concrete roads; that is, the cost of mixing and placing the concrete and cost of expansion joints and of miscellaneous supplies. The cost of earth work and the cost of hauling materials for concrete roads will not differ from the cost of the same class of work on macadam roads. Table 16 which gives an estimate of the cost of concrete roads is based on the information obtained in the construction of five sections of concrete road, so far as the cost of mixing and placing the concrete and the cost of expansion joints are concerned. But for the remainder of the items which enter into the cost of the concrete roads, such as earth work and hauling materials, the table is based on the data obtained in the construction of macadam roads.

In making this estimate, it is assumed that gravel concrete will be used and that the gravel will cost $1.50 per cubic yard f. o. b., cars at destination. The cost of hauling material is taken from the curve in figure 4 which is obtained from data on hauling crushed limestone. But in making these estimates proper corrections have been made for the difference in weight per cubic yard of the two materials.

It is also assumed that cement costs $1.20 per barrel f. o. b., cars at destination and no profits or overhead charges are considered in making up the table.

The following explanation of the manner in which the cost of a square yard of 6-inch concrete roadway is determined will show in general how the table is compiled:

The item "superintendence, watchman and miscellaneous labor" is taken from the actual cost for these items on concrete work done by the State Highway Commission.

The items "shaping road bed" and "trimming shoulders" are taken from table 14. The data obtained in the construction of the macadam roads also shows the cost of loading material on wagons to be 10.7 cents per cubic yard, and the cost per cubic yard for hauling ½ mile is found from the curve in figure 4. These two items added together and compensated for the difference in weight between gravel and crushed stone gives the item of loading and hauling materials. The other labor items are determined by the assumptions made as regards the cost of gravel and the cost of cement. The items "expansion joints," "coal, oil and miscellaneous supplies for mixer," "forms and other lumber," and "mixing and placing," are determined from table 17, which gives the cost of this work on the concrete roads constructed during 1912.

In this manner the cost per square yard for concrete road 6 inches thick is computed when the length of haul for materials is ½ mile. If the average haul is greater than ½ mile, the only item which changes is that of loading and hauling materials, which of course varies with the length of the haul. By reference to the curve in figure 4 the proper cost of hauling can be determined for one, two and three miles, and the item of loading and hauling computed accordingly; and finally, the cost per square yard for the concrete roadway 6 inches thick is determined for hauls of one, two and three miles. The cost per square yard for concrete road 7 inches thick is determined in the same general manner.

Having determined the cost per square yard for the two thicknesses given, and for the four lengths of haul given, the cost per mile for the concrete roadway of varying widths is determined by multiplying the number of square yards in a mile of road of the given width by the cost per square yard. The table also gives the cost of a mile of concrete road 6 inches thick and 10 feet wide, with 3 feet of macadam on each side of the concrete roadway. In computing this cost, the cost of the concrete roadway is determined as before explained, and to that is added one-third of the cost of a mile of 12 foot macadam road. This cost of the macadam, alongside the concrete, is determined on the assumption

that it is made two-thirds the thickness of a standard macadam road, and being one-half as wide will therefore require one-third of the material and labor of a 12 foot macadam road.

In the same manner the cost of a concrete road 12 feet wide, with 2 feet of macadam along each side, is determined with the assumption that the cost of the macadam will be one-sixth the cost of a standard 12 foot macadam road.

It should be noted that there is no cost given for a 7-inch pavement of the widths 10 and 12 feet, as it is thought there will be no occasion to make a concrete road 7 inches thick when it is less than 16 feet wide.

TABLE NO. 16.

Estimated cost of one mile of concrete road. Based on actual cost of work done by the Illinois Highway Commission, 1906-1912.

Width.	Cu. yds. gravel per mile.	Sq. yds. per mile.	Average haul ½ mile.		Average haul 1 mile.		Average haul 2 miles.		Average haul 3 miles.	
			Six inches thick.	Seven inches thick.	Six inches thick.	Seven inches thick.	Six inches thick.	Seven inches thick.	Six inches thick.	Seven inches thick.
10 ft. concrete with 6 ft. macadam...	Gravel.... 1,535 Stone..... 734	Con. 5,867 Mac. 3,520	$ 7,391	.....	$ 7,652	.....	$ 8,166	.....	$ 8,720	.....
12 ft. concrete with 4 ft. macadam...	Gravel.... 1,830 Stone..... 367	Con. 7,040 Mac. 2,347	7,802	.....	8,902	.....	8,563	.....	9,140	.....
16 feet.....	6 inches..... 2,200 7 inches..... 2,550	9,387	9,414	....	9,720	..... $11,080	10,230	..... $11,680	10,880	..... $12,400
18 feet.....	6 inches..... 2,331 7 inches..... 2,725	10,560	10,591	 12,050	10,930	 12,450	11,520	 13,150	12,200	 13,950
20 feet.....	6 inches..... 2,592 7 inches..... 3,025	11,733	11,768	 13,410	12,150	 13,840	12,780	 14,600	13,550	 15,480
24 feet.....	6 inches..... 3,110 7 inches..... 3,630	14,080	14,122	 16,060	14,580	 16,600	15,350	 17,530	16,320	 18,570

NOTE—
Cost of gravel assumed at $1.50 per cubic yard, f. o. b. cars destination.
Cost of cement assumed at $1.20 per barrel, f. o. b. cars at destination.
These costs do not include contractor's profits.

TABLE NO. 17.

Costs of concrete roads constructed in 1912.

Road.	McLean.	DeKalb.	Springfield.	Carlinville.
Amount of pavement laid	5,000 sq. yds.	7,334 sq. yds.	5,594 sq. yds.	7,111 sq. yds.
Thickness of pavement	6 inches	6½ inches	7 inches	6¼ inches
Width of pavement	45 ft	12 ft	18 ft	16 ft
Length of haul for materials	¼ mile	½ mile	¼ mile	Sand, 1½ mile; stone, ½ mi.
Cost of cement per bbl	$1.02-$1.06	55 cents	$1.02½	98 cents
Cement used per sq. yd. of pavement	.29 bbl	.31 bbl	.29 bbl	.33 bbl

Cost of labor and supplies.

Superintendence	$ 140 00	$ 200 00	$ 202 00	$ 157 50
Excavation		900 02		591 73
Shaping road bed	307 41	69 75	232 44	108 70
Trimming shoulders and side roads		72 70	211 38	
Loading and hauling sand and stone, including rehandling	267,34	596 02	603 50	795 05
Mixing and placing concrete	414 63	746 65	644 25	700 58
Watchman and miscellaneous labor	110 26	187 07	383 75	131 46
Cost of sand and stone f. o. b	1,017 63	1,671 00	1,622 01	741 00
Cost of cement f. o. b	1,547 15	1,250 00	1,551 17	2,307 90
Expansion joints	48 67	160 13	206 74	112 40
Reinforcing steel				100 00
Coal and oil for mixer and miscellaneous supplies	30 75	32 00	119 19	25 00
Forms and other lumber	35 00	119 77	18 33	31 75
Filling expansion joints next curb	45 18			
Car fares for men		51 16		
Pay for time of men coming and going		136 25		
Total	$3,964 02	$6,194 42	$5,734 76	$5,803 07

Cost per square yard for labor and supplies.

Superintendence	$0.028	$0.0273	$0.0361	$0.0220
Excavation		0.1227		0.0840
Shaping road bed	0.061	0.0095	0.0415	0.0153
Trimming shoulders and side roads		0.0099	0.0378	
Loading and hauling stone and sand including rehandling	0.053	0.0812	0.1078	0.1120
Mixing and placing concrete	0.083	0.1020	0.1150	0.0986
Watchman and miscellaneous labor	0.022	0.0255	0.0682	0.0184
Cost of sand and stone f. o. b	0.204	0.2280	0.2897	0.1050
Cost of cement f. o. b	0.309	0.1700	0.2772	0.3246
Expansion joints	0.010	0.0218	0.0369	0.0156
Reinforcing steel				0.0140
Coal and oil for mixer and miscellaneous supplies	0.006	0.0044	0.0213	0.0034
Forms and other lumber	0.007	0.0163	0.0033	0.0047
Filling expansion joints next curb	0.010			
Total	$0.793	$0.8186	$1.0352	$0.8176

LABORATORY WORK.

The work done in the laboratory may be classified as follows:

1. The routine testing of road and bridge materials.
2. Chemical investigations and researches.
3. Sampling and classification of samples.
4. Preparation of specifications for road materials.
5. The instruction of assistant engineers in the physical and chemical properties of road materials.
6. Inspection of bituminous roads.

ROUTINE TESTING OF MATERIALS.

This work comprises the examination and analysis of tars, asphalts and other road preservatives, creosoted paving blocks and creosoted timber, paints and rust preventives, rocks, slags, sands, gravels and cements to determine whether they are in accordance with the specifications under which they were purchased. Five hundred and eleven samples of various materials were received for examination during 1910, 1911 and 1912. Of these 257 were slags, rocks, sands or gravels; 15 cements; 9 creosoted blocks; 47 tars; 166 asphalts blown oils, cut back oil asphalts, residual petroleums and distillates; 5 tar and asphalt mixtures; 12 miscellaneous materials.

TESTS OF BITUMINOUS ROAD MATERIALS.

The laboratory tests of bituminous materials are, with a few slight modifications and a few additions, those used by the Office of Public Roads, U. S. Department of Agriculture, as described in bulletin No. 38 of that office. All asphalts are submitted to the following examinations: Specific gravity, melting point, flash point, burning point, ductility, brittleness, evaporation, total bitumen, 86° B naptha insoluble, fixed carbon and ash. The following tests: Melting point, flash point, burning point and ductility have been applied only in 1912, the temperature of the evaporation test being also changed from 170° C to 163° C. The method of the determination of the paraffin scale is not an accurate one, and only very greasy and short materials are subjected to this test.

Oil residuums high in organic matter insoluble in carbon disulphide are also subjected to the determination of the carbenes or bitumen insoluble in carbon tetrachloride.

Tars.

Tars and tar products are subjected to the following tests: Specific gravity, free carbon or organic matter insoluble in carbon bisulphide, ash, consistency as given by the float test and fractional distillation.

Table Nos. 18, 19, 20 and 21 give the results of tests made on bituminous binders.

The specific gravity of the tars employed in 1910, 1911 and 1912 has varied from 1.15 for water gas tar containing 2.9 per cent of free carbon to 1.315 for a special heavy tar. On analysis this special tar was found to have been prepared from a heavy tar containing 30.7 per cent free carbon to which 10 per cent of mineral matter has been added. Tars containing such a high per cent of free carbon have usually been found to be brittle and it has been thought wise to limit the amount of free carbon to a maximum of 20 per cent; the corresponding specific gravity of the tar being also limited to a maximum of 1.24 to provide for this amount of free carbon and to exclude any large amount of ash. But the specific gravity of tars tested in 1912 is higher than those previously examined.

The consistency of the tars used during 1910, 1911 and 1912 presented wide variations, the float test at 50° C as given by the Howard & Morse float apparatus ranging from 20 seconds for a light tar to 1 hour and 36 minutes for a heavy brick paving filler. Tars having a consistency such that they will give a float test from 2 to 3 minutes have been used in 1910 and 1911 for construction work by the penetration method. In 1912, a float test of 1½ to 2½ minutes was required.

Wide variations were also found in the fractional distillation of the tars used during 1910, 1911 and 1912. The position of the thermometer in the retort during distillation has been modified in 1912 and the values obtained on distillation of tars in 1910 and 1911 can not, therefore, be compared with those obtained in 1912. With the methods of distillation used in 1910 and 1911 in which the bottom of the bulb of the thermometer was kept level with the bottom of the juncture of the stem and body of the retort, it seems that the best results in road construction were obtained with tars giving the following fractions:

Up to 110° C, not over 2 per cent distillate, free from ammoniacal water; from 110° C to 170° C, not more than 5 per cent distillate, of which not more than one-fourth is naphthalene; from 170° C to 270° C, not more than 30 per cent nor less than 20 per cent distillate, of which not more than one-third is solid at room temperature.

The first fraction up to 110° C consists of water and first light oils. The presence of an ammoniacal solution is always an indication that the tar has not been properly refined, and is believed to be detrimental.

The fraction from 110° C to 170° C contains light oils liquid at room temperature 25° C and naphthalene which is solid at ordinary temperature. The influence of both liquid light oils and naphthalene on the consistency of tars is very marked and the naphthalene being volatile, the consistency of a tar high in naphthalene will change rapidly after being applied to a road. The degree of fluidity which a road tar main-

tains under service conditions being a most important consideration, it has been found advisable therefore to limit the amount of naphthalene as much as possible.

The amount of light oils and naphthalene being limited, the consistency of the tar will depend on the amount of the heavy oils which compose the fraction distilling from 170° C to 270° C. A good consistency for tars used in road construction by the penetration method seems to be obtained with the amount of heavy oils varying from 20 to 30 per cent, not more than one-third of this amount being solid.

It is believed that a tar with the foregoing composition will maintain its original consistency for some time. With the present method of distillation in which the top of the bulb of the thermometer is kept level with the bottom of the juncture of the stem and the body of the retort, the yield of each fraction except the first has been lowered. While the fraction obtained up to 110° C is about the same as in the old method of distillation, the quantity distilling from 170°-270° C is about one-half of what was formerly obtained. Instead of stopping the distillation at 270° C, it is carried on up to 315° C, the amount of total distillate to 315° C, being approximately the same as that obtained to 270° C with the thermometer placed as formerly. With heavy tars, such as were available in 1912, the amount of distillate from 110°-170° C was very small, and in most cases no fraction was obtained.

Asphalts.

The asphalts used by the Illinois Highway Commission during 1910, 1911 and 1912 have a specific gravity ranging from 0.968 for a short asphalt low in fixed carbon and high in paraffin scale to 1.060 for a fluxed native asphalt high in fixed carbon and containing 4.4 per cent of ash. As a rule it has been found that asphalts of low specific gravity are usually low in ductility, and contain paraffin scale, while asphalts high in specific gravity are usually more sticky and more ductile. Where high specific gravity is not caused by mineral matter, an increase of specific gravity indicates an increase in fixed carbon, and, if the fixed carbon is in excess, an increase in brittleness. It has been found that 12 per cent of fixed carbon should not be exceeded, the specific gravity being not less than 0.96. Large loss on evaporation is an indication that the material is made from a brittle residue fluxed back to good consistency.

Experience has shown that an asphalt should contain asphaltene (bitumen insoluble in 86° B naphtha) to the extent of 20 to 25 per cent of the total bitumen. An excess of asphaltene is an indication of brittleness, and a deficiency a lack of bonding value.

Most of the asphalts used by the Illinois Highway Commission in 1910 and 1911 for construction work by the penetration method have been low penetration material, the penetration determined with the Dow machine, using a No. 2 needle and 100 grams weight during 5 seconds and at a temperature of 25° C varying between 5.0 mm. and 10.0 mm.

In 1912 some of the asphalts used were mixtures having a penetration as high as 25mm. But these mixtures were known to harden rapidly, and give little or no trouble when applied to the road surface.

To prevent the use of material that would bleed in warm weather, it was necessary to determine the melting point, flash point, and burning point of these mixtures. The investigation of brittle and short products and of their mixtures shows also that the ductility test served to measure the binding value of asphalts and to a certain extent the brittleness of the material. The ductility test was applied to asphalts at 25° C, using the Kirschbraun machine.

WOOD PRESERVATIVES AND MISCELLANEOUS TESTS.

The routine testing of the laboratory comprised also the testing of creosoted blocks and wood preservatives, paints and miscellaneous products. Creosoted blocks used for paving were required to contain a specific amount of coal tar creosote per cubic foot, and all samples of blocks submitted for use were examined to determine this creosote content. Paints were tested as to their nature and their value as rust preventives. Slags, rocks, sand and gravels were subjected to examination to determine grading of sizes. Cement was tested according to the methods adopted by the American Society for Testing Materials.

SAMPLING AND CLASSIFICATION OF SAMPLES.

During 1910, 1911 and 1912, much attention has been given to the selection of a suitable container in which to keep bituminous compounds for filing, and to the handling of samples in the laboratory. The most suitable method devised at present is as follows:

Samples are sent to the laboratory in the usual five cent tin pails, which can be readily obtained anywhere. Instructions are given to road engineers as to the method of selecting good representative samples. After analysis of the samples in the laboratory, enough material is left to fill a quart tin can, such as is used for canned fruit. The cans are labeled with the sample number, date received, car number, trade name, manufacturer, road on which they are used, township and county, and are filed for further reference. These quart tin cans are very satisfactory to handle and when the lid is kept tight the samples will keep for years without change. The ordinary glass fruit jars have been tried, but have been found to be too deep and to have too small an opening for convenient handling of bituminous material. These jars, however, are now in use for all samples of sand, gravel, rocks, slags, cement, etc., and are very convenient because they permit a general inspection of the sample without emptying the jar.

A system of keeping a double record of all analyses has also been devised, and found to give very good results. Each analysis is entered on laboratory blanks; all data are then recorded in a book somewhat similar to a ledger, and the blanks filed. Three books with the record of all analyses have been in use; one for bituminous compounds, one for wood preservatives, paints and miscellaneous materials, the third for stone, sand and gravels.

PREPARATION OF SPECIFICATIONS FOR ROAD MATERIALS.

During 1910, 1911 and 1912, it has been the object of the Illinois Highway Commission to develop a set of specifications which would insure a uniform and satisfactory grade of material for road construction. A constant effort has been made to keep the specifications up to date and to make them consistent with the result of the latest investigations. No fundamental changes have been made in the specifications for tar and asphalts, but many minor changes and additions have taken place during the past two years. Specifications for creosoted paving blocks and creosoted timber have been adopted, and specifications for paints and rust preventives are now in preparation.

INSTRUCTION OF ASSISTANT ROAD ENGINEERS.

The necessity of having engineers on road construction coöperate with the laboratory in road material investigations made it advisable to have all road engineers work a short time in the laboratory. As far as this is possible, the field engineer passes two weeks in the laboratory, during which time he receives a general knowledge of the composition of bituminous road materials and a more intimate acquaintance with the physical qualities of the materials which he uses in construction.

INSPECTION OF BITUMINOUS ROADS.

To be of any practical value, laboratory research work on bituminous material requires a close coöperation with field investigations. It has often been stated that the road engineer cannot rely upon what little field experience he possesses in the use of bituminous compounds, but it is also true that laboratory results are not always conclusive, soil and climate conditions having much to do with the good behavior of road materials. It has been the object of the Illinois Highway Commission in the past years to corroborate the laboratory investigations by observation on roads constructed with the materials under investigation. As far as it was possible, two or more different bituminous materials were used in portions of the same road in the same neighborhood. By this method, asphalts and tars were used under conditions very similar so far as soil and climate were concerned. A record was also kept of all other conditions; temperature at which the bituminous material was applied, temperature of the air, quantity of material used and method of spreading, quality of sand and stone used, weather conditions during the days following applications of the material, and amount of traffic. At each inspection a record of the wear and general condition of the road was noted, together with the climatic conditions at the time of the inspection. The record of the condition of the various bituminous macadam roads during each season is given in table 13.

TABLE

Tests of asphalts

Laboratory number.	Specific gravity, 25° C.	Float test, 50° C.	Penetration 25° C., 100 gr., 5 sec. mm.	Evaporation 5 hours at 170° C.			Bitumen soluble in CS_2—per cent.	Organic matter insoluble in CS_2—per cent.	Bitumen insoluble in 86° naptha per cent total bitumen.	Fixed carbon—per cent.	Ash—per cent.	Brittleness test.	Parrafin scale—per cent.
				Loss—per cent.	Penetration of residue—mm.	Change penetration—per cent.							
102	0.962	[3]1°1"	[2]4.5	[2]1.09	[2]4.5	0	.....	.....	.....	.....	.....	.....	.....
130	0.970	.....	11.2	.....	7.2	36	99.95	0.00	23.65	11.70	0.05	.....	.....
131	0.974	.....	12.3	0.17	8.2	33	99.9	0.05	23.10	11.85	0.05	.....	.....
135	0.990	.....	9.3	0.12	9.3	0	99.85	0.05	25.80	12.60	0.10	.....	.....
143	0.981	.....	10.4	0.15	10.0	4	98.9	0.70	23.50	11.6	0.40	.....	.....
146	0.992	.....	9.8	0.27	7.8	20	99.6	0.3	23.10	11.95	0.10	.....	.....
154	0.993	.....	11.6	.....	7.8	33	99.6	0.3	22.70	12.2	0.10	.....	.....
162	0.990	.....	9.2	0.11	6.3	31	99.8	0.2	23.4	12.2	0.00	.....	.....
171	0.998	.....	6.8	0.15	6.6	3	99.9	.....	23.3	12.7	.....	.....	.....
202	0.982	.....	9.5	0.13	7.9	17	99.0	0.65	23.8	12.5	0.35	Not brittle.	.....
119	.....	.....	8.0	.....	.....	.....	99.7	.....	24.6	13.41	.....	.....	.....
150	0.985	.....	9.4	0.25	8.2	13	99.6	0.00	23.35	10.75	0.40	.....	.....
151	0.975	.....	5.9	0.30	5.2	11	98.7	0.60	26.6	13.8	0.70	.....	0.48
157	0.977	.....	9.4	0.28	8.4	11	98.5	1.10	24.6	10.90	0.40	.....	.....
158	0.977	.....	9.6	0.30	8.6	10	98.4	1.10	23.6	10.65	0.50	.....	.....
132	0.974	0'45"	.....	0.80	.....	.....	99.85	0.05	10.30	8.0	0.10	.....	.....
133	0.977	0'42"	.....	0.90	.....	.....	99.9	0.05	10.10	8.0	0.05	.....	.....
136	0.988	.....	6.2	0.21	4.8	22	99.35	0.25	31.0	13.75	0.40	.....	.....
139	0.965	.....	16.0	0.40	.....	.....	99.8	.....	16.10	7.8	.....	.....	.....
144	0.970	.....	14.4	0.95	11.7	19	99.8	0.0	23.1	8.35	0.20	Not brittle.	.....
147	0.970	.....	14.6	0.72	11.6	21	99.85	0.05	22.4	8.15	0.10	.....	.....
148	0.972	.....	10.3	0.72	8.2	20	99.8	0.10	22.9	9.6	0.10	.....	.....
149	0.974	.....	5.9	0.68	4.6	22	99.7	0.0	27.5	10.35	0.30	.....	.....
152	0.974	.....	5.6	0.45	4.8	10	99.6	0.35	27.5	9.50	0.05	.....	0.85
153	0.975	.....	5.4	0.50	4.7	12	99.8	0.15	26.8	8.75	0.05	.....	.....
160	0.976	.....	6.4	0.94	5.2	19	99.6	0.0	27.4	10.0	0.40	.....	.....
164	0.976	.....	8.0	0.60	6.7	16	99.9	0.0	24.5	10.0	0.10	Not brittle.	.....
165	0.983	.....	2.6	0.05	2.5	4	98.7	0.8	22.9	13.2	0.5	.....	.....
166	0.976	.....	8.4	0.60	7.0	20	99.9	0.0	24.9	10.35	0.1	.....	.....
172	0.976	.....	9.4	0.65	7.4	21	99.7	.....	26.0	11.3	.....	.....	.....
190	0.968	.....	15.9	0.90	12.6	15	100.	0.0	23.5	8.65	.....	Not brittle.	0.51
191	0.975	.....	7.4	0.70	6.7	10	99.9	.....	24.1	9.95	.....	.....	.....
197	0.967	.....	15.0	0.80	12.1	19	99.5	0.3	22.0	9.15	0.20	.....	.....
203	0.969	.....	[4]9.1	0.87	[4]8.1	11	99.7	0.25	21.60	6.95	0.05	Not brittle.	.....
163	0.991	.....	7.3	0.23	6.6	10	99.7	0.20	21.0	9.10	0.1	.....	.....
167	0.997	.....	7.0	0.10	6.4	9	99.8	0.0	25.5	10.05	0.20	.....	.....
175	0.998	.....	7.2	0.27	6.3	11	99.9	0.0	29.3	8.45	0.10	.....	.....
168	1.020	.....	8.6	0.29	4.6	46	99.6	0.0	16.1	11.0	0.40	Brittle.....	.....
170	0.9916	.....	6.8	0.30	4.2	38	99.9	0.0	15.2	11.8	0.10	..do.....	.....
173	1.026	.....	7.4	0.15	5.0	31	99.9	0.0	15.7	10.6	0.10	..do.....	.....
174	1.026	.....	7.7	0.11	5.2	28	99.9	0.0	15.5	11.15	0.10	..do.....	.....
179	1.022	.....	7.7	0.25	5.4	30	99.9	0.0	15.25	10.35	0.10	..do.....	.....
180	1.023	.....	9.3	0.30	5.6	38	99.85	.....	14.95	11.10	.....	..do.....	.....
181	1.023	.....	8.9	1.10	4.0	55	99.9	0.0	21.4	12.9	0.1	..do.....	.....
182	1.022	.....	11.0	0.50	6.3	36	99.9	0.0	14.8	10.65	0.10	..do.....	.....
155	1.060	.....	7.2	4.26	3.6	50	95.6	1.2	22.6	11.1	3.20	..do.....	.....
156	1.062	.....	8.5	4.26	3.5	58	95.8	1.2	23.25	11.05	3.0	..do.....	.....
178	1.065	.....	4.0	4.25	1.7	58	95.5	1.25	24.2	12.4	3.25	..do.....	.....
193	1.054	.....	4.9	4.62	1.3	71	96.3	0.65	23.3	10.95	3.10	..do.....	.....
204	0.984	.....	5.5	0.43	4.4	20	99.55	0.0	26.45	11.05	0.45	Not brittle.	.....
201	1.017	.....	10.7	0.17	8.1	24	99.35	0.50	20.05	14.65	0.15	.....	.....

[1] At 65½° C.
[2] At 3° C.
[3] At 163° C.
[4] Wt. 50 gr.

NO. 18.

—1910-1911.

Where used.			Remarks.
Road.	Township.	County.	
Ivesdale	Bement	Piatt	
Prospect Heights	Richwood	Peoria	Undetermined; promised good results; inclined to bleed.
..do	..do	..do	..do
S. Depot st	O'Fallon	St. Clair	Satisfactory at end of two seasons
Main st	Beaver	Iroquois	Satisfactory at end of three seasons
Beardstown-Chandlerville	Road Dist. No. 3	Cass	Undetermined; promised good results; inclined to bleed
Beardstown-Virginia	..do	..do	Satisfactory at end of two seasons
Main st	Crescent City	Iroquois	..do
Church st	Drummer	Ford	Built in 1912
Fair grounds	Capitol	Sangamon	Satisfactory at end of three seasons; light traffic
Oregon Br. floor	Oregon	Ogle	
Court st	Kankakee	Kankakee	Not determined
S. Morris av	Bloomington	McLean	Unsatisfactory; replaced in one season
Belleville st	Lebanon	St. Clair	Satisfactory for two seasons; became granular.
..do	..do	..do	..do
Virginia	Road Dist. No. 4	Cass	
..do	..do	..do	
S. Depot st	O'Fallon	St. Clair	Satisfactory three seasons; slightly granular
Range st	Oblong	Crawford	Satisfactory at end of two seasons
..do	..do	..do	..do
..do	..do	..do	..do
..do	..do	..do	..do
..do	..do	..do	..do
S. Morris av	Bloomington	McLean	Unsatisfactory, disintegrating first season; replaced
Mazon av	Dwight	Livingston	Unsatisfactory, disintegrating
..do	..do	..do	..do
Grove st	Mt. Pleasant	Whiteside	Satisfactory end 1 year
..do	..do	..do	..do
..do	..do	..do	..do
..do	..do	..do	..do
..do	..do	..do	..do
..do	..do	..do	..do
Spring st. bridge	Galena	JoDaviess	Not used
Fair grounds	Capitol	Sangamon	Satisfactory at end of 3 seasons
Grove st	Mt. Pleasant	Whiteside	Satisfactory at end of one season
S. Morris av	Bloomington	McLean	..do
Grove st	Mt. Pleasant	Whiteside	..do
Bridgeport	Whitehall	Greene	Brittle, unsatisfactory; replaced first season
Grove st	Mt. Pleasant	Whiteside	Replaced, only little used
Jerseyville	Fieldon	Jersey	Not used
..do	..do	..do	..do
..do	..do	..do	..do
Momence			..do
Bridgeport	Whitehall	Greene	Same as for No. 168
Morris av	Bloomington	McLean	Not used
Alton st	Lebanon	St. Clair	Satisfactory at end of 2 seasons; light traffic
..do	..do	..do	..do
Bridgeport	Whitehall	Greene	Satisfactory at end of 1 season
Church st	Drummer	Ford	..do
Fair grounds	Capitol	Sangamon	Satisfactory at end of 3 seasons
..do	..do	..do	..do

TABLE

Tests of tars

Laboratory number.	Specific gravity at 25° C.	Float test at 50° C.	Bitumen soluble in CS_2—per cent.	Free carbon—per cent.	Ash—per cent.	Distillation.								Pitch—per cent by volume.
						Water—per cent by volume.	First light oils 0°–110° C.—per cent by volume.	Second light oils 110°–170°C.		Dead oils 170°–270°C.		Heavy oils 270°–315° C.		
								Per cent by volume.	Per cent soluble by volume.	Per cent by volume.	Per cent soluble by volume.	Per cent by volume.	Per cent soluble by volume.	
101	1.230	[1]24″	75.0	25.0	.....	1.04	0.72	4.64	25N	32.72	75	.....	.....	60.88
103	1.240	155′	77.7	22.3	.....	0.80	0.4	4.4	60	22.10	70	.....	.....	72.30
104	1.222	120″	79.0	21.0	.....	0.66	.....	6.70	90	24.0	35	[2]8.00	[2]100	68.64
105	1.237	190″	80.5	19.5	.....	1.33	.....	0.66	.....	26.67	60	[2]13.33	[2]100	71.34
106	1.236	1′55″	78.9	21.1	.....	0.0	0	0	.....	32.00	75	[2]10.67	[2]100	68.0
107	1.243	2′–8″	79.3	20.7	.....	2.7	0	0	.....	20.0	25	[2]9.0	[2]100	77.30
108	1.241	2′23″	79.8	21.0	.....	0.0	1.33	0	.....	30.67	50	[2]4.0	[2]100	68.0
109	1.243	1′55″	81.4	18.55	.....	0	0	5.33	100N	28.67	90	[2]3.33	[2]100	66.0
110	1.219	2′20″	81.7	18.27	.....	4.0	0	0	.....	24.67	3	.....	.....	71.33
111	1.256	2′35″	77.9	22.13	.....	0.7	0	2.67	100N	21.33	80	[2]15.33	[2]100	75.33
112	1.238	2′10″	77.9	22.10	.....	0	0	6.67	100N	21.33	90	.....	.....	72.0
113	1.239	2′15″	77.8	22.2	.....	0	0	0	.....	24.67	40	.....	.....	75.33
121	1.238	2′20″	79.3	20.7	.....	0	0	0	.....	22.20	10	.....	.....	77.8
123	1.212	1′37″	73.45	26.45	.....	Trace	1.33	0	.....	23.33	15	.....	.....	75.34
125	1.237	2′40″	77.7	22.33	.....	0	0	0	.....	17.33	.....	.....	.....	82.67
127	1.227	1′49″	82.35	17.65	.....	0	0	0.4	.....	15.20	13	18.4	100	84.4
137	1.232	1′56″	80.7	19.10	0.20	0	0	0.4	100N	10.80	100	.....	.....	88.8
169	1.246	2′52″	79.55	20.30	0.15	0	0	0	0	15.20	30	.....	.....	84.8
177	1.272	3′45″	69.25	30.15	0.60	0	0	0.5	100N	13.0	15	.....	.....	86.5
209	1.284	15′ 0″	69.15	30.7	0.15	0	0	0	0	4.4	0	16.0	90	95.6
120	1.213	2′10″	81.35	18.65	.....	0	0	6.0	.....	30.0	.....	.....	.....	64.0
122	1.227	1′25″	78.33	21.67	.....	0	0	4.0	.....	28.6	10	.....	.....	67.4
208	1.271	4′ 5″	71.4	28.50	0.10	0	0	0	0	14.4	40	13.2	100	85.6
126	1.218	38″	81.9	18.10	.....	0	0	1.0	100N	28.0	40	.....	.....	71.0
161	1.166	40″	95.4	4.4	0.20	0	0	0	.....	34.0	12	.....	.....	66.0
176	1.315	14′ 0″	65.1	25.6	9.30	0	0	1.2	100N	9.2	10	.....	.....	89.5

[1] At 65° C.
[2] To 360° C.

NO. 19.

—1910-1911.

Where used.			Remarks.
Road.	Township.	County.	
Tri-City	Venice	Madison	Satisfactory for one season; extra heavy traffic
West st	Edwardsville	..do	Satisfactory for three seasons
Tri-City	Venice	..do	Too soft, ran out of the road
Davis st	Bushnell	McDonough	Satisfactory but with 2 course treatment for three seasons
West Cross st	Mt. Sterling	Brown	Seemed brittle, pulled off by mud
Tri-City	Venice	Madison	Satisfactory for one season; extra heavy traffic
Elburn	Blackberry	Kane	Surface work lasted but one season
West Cross st	Mt. Sterling	Brown	Seemed brittle, pulled off by mud
Flosmoor	Rich	Cook	Seemed brittle, road raveled
..do	..do	..do	Less brittle, better results than 111
Bailey's lane	Yellowhead	Kankakee	Seemed satisfactory under light traffic, broke up under heavy hauling
West Bluff	Hollis	Peoria	Satisfactory for three seasons
..do	..do	..do	Showed best results of all
..do	..do	..do	Samples used on this road
..do	..do	..do	All seemed satisfactory for 3 seasons
New Philadelphia	Mound	McDonough	Tar seemed to disintegrate; pulled out by mud
Flosmoor	Rich	Cook	Seemed satisfactory
Range st	Momence & Ganeer	Kankakee	Undetermined
Fair grounds	Capitol	Sangamon	One course treatment, began to pull out
Paxton	Patton	Ford	Satisfactory; traffic light
..do	..do	..do	..do
Fair grounds	Capitol	Sangamon	Seemed satisfactory, has no mud tracked on
Bailey's lane	Yellowhead	Kankakee	Seemed satisfactory under light traffic
Mazon av	Dwight	Livingston	Satisfactory during one season
Range st	Momence	Kankakee	Undetermined; did promise good results

TABLE

Tests of

Laboratory number.	Specific gravity 25° C.	Melting point in °C.	Flash point in °C.	Burning point in °C.	Ductility in cm. 25° C.	Brittleness at 0° C.	Penetration at 25° C., 100 gr. 5 sec. in mm.	Evaporation 5 hours 163° C.			Bitumen soluble in CS_2 in per cent.	Organic matter insoluble in CS_2, in per cent.	Bitumen insoluble in 86° naphtha in percent of total bitumen.
								Loss in per cent.	Penetration of residue in mm.	Change in penetration in mm.			
195	1.024	46.5	255	290	Over 100	Brittle	9.1	0.33	5.8	47	99.95	0.05	17.7
196	1.020	46.5	255	290	Over 100	..do	8.8	[1]	5.0	43	99.95	0.0	17.3
205	0.993					Not brittle	7.1	0.10	5.7	20	99.8	0.0	25.2
229	0.988	59	265	295	7	..do	10.9	0.22	7.8	28	99.6	0.1	23.5
230	0.989	60	[1]	[1]		..do	10.8	[1]	7.6	29	99.6	0.1	23.9
231	0.988	63	275	305		..do	8 9	0.24	6.5	27	99.6	0.1	24.3
239	0.988	61	275	305	19	..do	8.8	0.20	8.0	9	99.8	0.0	23.2
240	0.986	60.5	275	305	24	..do	9.1	0.19	8.0	12	99.9	0.0	23.4
241	0.985	61.5	275	305	31	..do	9.2	0.19	8.1	12	99.9	0.0	23.2
243	0.986	60	275	305	34	..do	8.7	0.07	7.7	11	99.9	0.0	23.4
245	0.990	62	270	300	14.5	..do	7.7	0.07	6.8	12	99.9	0.0	25.8
247	0.992	63	270	305	17	..do	7.5	0.08	6.0	20	99.9	0.0	24.6
248	0.986	60	275	310	21.5	..do	10.0	0.07	7.5	25	100.0	0.0	23.2
249	0.987	64	280	310	12.5	..do	8.1	0.04	6.3	22	99.9	0.0	23.0
270	0.988	60	270	305	15	..do	8.4	[1]	7.2	14	99.8	0.1	23.1
272	0.991	68	270	305	8	..do	8.2	0.16	7.2	12	99.8	0.1	23.9
275	0.988	63	270	305	13	..do	7.4	0.13	5.7	23	99.8	0.1	24.3
276	0.989	63	270	305	12	..do	7.6	0.14	5.6	26	99.8	0.1	24.4
280	0.990	64	270	305	10.5	..do	7.1	0.12	5.8	18	99.8	0.1	24.1
281	0.990	60	275	305	11	..do	8.1	0.16	6.5	20	99.7	0.2	25.5
287	0.988	61	265	305	30.5	..do	9.9	[1]	8.3	16	99.9	0.0	22.8
292	0.989	62	275	305	12	..do	7.7	0.16	6.1	21	99.8	0.1	25.2
303	0.992	60.5	270	310	10	..do	6.7	0.23	5.3	21	99.8	0.1	24.0
306	0.992	62	270	305	9.5	..do	6.0	0.12	4.9	18	99.8	0.1	24.4
314	0.989	64	275	310	8	..do	7.2	0.09	6.3	12	99.7	0.2	24.0
315	0.987	64	270	305	11	..do	7.5	0.20	5.6	25	99.8	0.1	25.4
317	0.989	66	270	305	7.5	..do	6.9	0.09	5.3	23	99.9	0.0	25.4
228	0.980	57	250	285	21	..do	11.8	[1]	[1]	[1]	99.8	0.0	21.7
234	0.980	57	[1]	[1]		..do	12.0	[1]	[1]	[1]	99.8	0.0	21.7
235	0.978	128	210	255		..do	4.0	0.39	3.9	3	99.9	0.25	30.6
236	0.976	130	205	255		..do	3.9	0.45	3.7	5	99.05	0.25	30.2
242	0.973	67.5	225	265	5.5	..do	12.4	0.40	11.1	10	99.6	0.1	22.4
246	0.970	65	240	275	25	..do	14.4	0.38	12.4	14	99.9	0.0	21.2
262	0.992	73	250	290	3.5	Brittle	2.8	0.69	2.0	29	99.85	0.05	23.2
277	0.974	73	245	285	61	Not brittle	8.6	0.49	7.0	19	99.6	0.1	23.3
251	1.058	48	190	225	61	Slightly brit.	11.5	3.35	4.5	61	95.3	0.8	23.4
278	1.044	47	195	225	63	..do	14.1	3.33	5.6	60	96.5	0.9	23.7
279	1.045	47	195	225	72	..do	14.1	3.52	5.3	62	96.6	0.9	23.4
237	0.994	45	255	290	Over 100	Not brittle	21.0	0.42	11.0	48	99.8	0.0	20.5
238	0.995	51	265	300	Over 100	..do	16.0	0.29	9.9	38	99.9	0.0	21.4
266	0.995	52	265	305	Over 100	..do	15.4	0.28	10.2	34	99.9	0.0	21.0
267	1.002	51	250	290	84	..do	15.5	0.96	8.0	48	99.6	0.1	21.0
294	1.002	49	260	295	Over 100	..do	12.4	0.42	7.3	41	99.8	0.1	22.1
295	1.002	49	260	295	Over 100	..do	11.2	0.46	6.2	44	99.8	0.1	22.4
296	0.999	47	260	300	Over 100	..do	12.2	0.16	8.2	33	99.9	0.0	21.4
297	0.997	49	265	300	Over 100	..do	11.8	0.35	7.6	36	99.8	0.0	21.7
298	0.998	48	260	300	Over 100	..do	12.2	0.26	8.3	32	99.9	0.0	21.9
299	0.998	48	260	300	Over 100	..do	12.5	0.23	8.7	30	99.9	0.0	21.8
300	1.002	44	255	290	Over 100	..do	14.5	0.41	7.6	47	99.8	0.1	20.7
301	0.999	49	250	290	75	..do	11.7	0.60	6.8	42	99.8	0.1	22.3
268	1.016	43	240	280	Over 100	..do	18.5	0.55	9.2	50	99.8	0.0	18.5
269	1.016	42	240	280	Over 100	..do	18.2	[1]	8.8	52	99.8	0.05	18.4
286	0.988	61.5	225	290	25	..do	5.4	1.44	3.2	41	99.6	0.3	22.6

[1] Foaming.

NO. 20.

asphalts—1912.

Fixed carbon in per cent.	Ash in per cent.	Where used.			Remarks.
		Road.	Township.	County.	
10.95	0.0	Cemetery	Whitehall	Greene	"a"
11.35	0.05	..do	..do	..do	..do
12.1	0.2	Depot st	O'Fallon	St. Clair	Used in lower course
13.95	0.3	Range st	Momence	Kankakee	"a"
13.9	0.3	..do	..do	..do	..do
14.15	0.3	Cemetery	Pekin	Tazewell	Satisfactory at end of one season
12.75	0.2	Church st	Drummer	Ford	"a"
12.7	0.1	..do	..do	..do	..do
12.7	0.1	..do	..do	..do	..do
12.6	0.1	..do	..do	..do	..do
12.7	0.1	Western av	Mattoon	Coles	..do
12.8	0.1	..do	..do	..do	..do
12.2	0.0	..do	..do	..do	..do
12.3	0.1	Range st	Momence	Kankakee	..do
12.6	0.1	Church st	Drummer	Ford	..do
12.8	0.1	Bridgeport	Whitehall	Greene	..do
13.6	0.1	Cemetery	Pekin	Tazewell	Satisfactory at end of one season
13.6	0.1	Heights rd	Richwood	Peoria	"a"
12.7	0.1	Morris av	Bloomington	McLean	Applied in 1912
13.5	0.1	Western av	Mattoon	Coles	"a"
12.8	0.1	Chicago-Batavia	Milton	DuPage	..do
13.3	0.1	Prospect av	Peoria Heights	Peoria	..do
13.6	0.1	Tri-City	Stites	St. Clair	Applied in 1912
13.6	0.1	..do	..do	..do	..do
13.1	0.1	..do	..do	..do	..do
13.5	0.1	E. Davis; W. Hurst	Bushnell	McDonough	"a"
13.5	0.1	Fieldon; Cemetery	Jerseyville; Whitehall	Jersey; Greene	do
11.85	0.2	Fieldon	Jerseyville	Jersey	..do
11.7	0.2	..do	..do	..do	..do
11.4	0.85	Spring st. bridge	W. Galena	JoDaviess	Used for mastic bridge floor; satisfactory at end of first season
11.6	0.7	..do	..do	..do	..do
9.4	0.3	Morris av	Bloomington	McLean	"a"
8.7	0.1	Trenton	Helvetia	Madison	..do
9.5	0.1	..do	..do	..do	..do
10.4	0.3	Cemetery	Pekin	Tazewell	Applied in 1912
11.3	3.9	Church st	Drummer	Ford	..do
12.1	2.6	..do	..do	..do	"a"
12.1	2.5	..do	..do	..do	..do
11.5	0.2	Fieldon	Jerseyville	Jersey	Applied in 1912
12.2	0.1	..do	..do	..do	..do
12.0	0.1	..do	..do	..do	..do
13.1	0.3	Range st	Momence	Kankakee	..do
12.8	0.1	Prospect av	Peoria Heights	Peoria	Applied in 1912; tank sample
12.8	0.1	..do	..do	..do	Applied in 1912; nozzle sample
12.6	0.1	Hurley	Milton	DuPage	Applied in 1912; tank sample
12.7	0.2	..do	..do	..do	Applied in 1912; nozzle sample
12.7	0.1	..do	..do	..do	Applied in 1912; tank sample
12.7	0.1	..do	..do	..do	Applied in 1912; nozzle sample
12.5	0.1	Prospect av	Peoria Heights	Peoria	Applied in 1912; tank sample
12.8	0.1	..do	..do	..do	Applied in 1912; nozzle sample
11.9	0.2	Morris av	Bloomington	McLean	Applied in 1912; tank sample
11.9	0.15	..do	..do	..do	Applied in 1912; nozzle sample
9.5	0.1	Trenton	Helvetia	Madison	Applied in 1912

TABLE

Tests of

Laboratory number.	Specific gravity.	Float test at 50° C.	Brittleness test at 0°C.	Bitumen soluble in CS_2—per cent.	Free carbon in per cent.	Ash—per cent.	Distillation.			
							0° C.–110° C.		110° C.–170° C.	
							Water—percent by volume.	First light oils—per cent by volume.	Second light oils—per cent by volume.	Solids—per cent by volume.
263	1.205	20"	Not brittle.....	88.95	10.9	0.15	Not ammonia 1.2	0	2.8	100
265	1.186	40"	..do.....	85.9	14.0	0.1	0.4	0	0.6	50
271	1.210	20"	..do.....	86.9	13.0	0.1	Slightly ammonia 0.4	0	1.2	50
289	1.249	1'50"	..do.....	82.4	17.5	0.1	0	0	0	0
293	1.249	1'40"	..do.....	79.4	20.5	0.1	0	0	0.4	100
302	1.264	2'40"	..do.....	79.6	20.3	0.1	0	0	0	0
307	1.243	2'45"	Slightly brittle.	84.5	15.3	0.2	0	0	0	0
311	1.253	1'40"	Not brittle.....	78.7	21.2	0.1	0	0	0	0
316	1.255	2' 5"	..do.....	79.3	20.5	0.2	0	0	0	0
318	1.257	1'50"	..do.....	79.3	20.6	0.1	Slightly ammonia 1.2	0	0	0
319	1.258	1'35"	..do.....	80.3	19.5	0.2	Ammoniacal 0.8	0	0	0

NO. 21.

tars—1912.

Distillation.				Pitch at 315° C. —per cent by volume.	Where used.		
170° C.-270° C.		270° C.-315° C.					
First heavy oils—per cent by volume.	Solids—per cent by volume.	Second heavy oils—per cent by volume.	Solids—per cent by volume.		Road.	Township.	County.
22.8	45	14.8	100	58.4	Range st.....	Momence.....	Kankakee .....
18.4	100	5.6	70	75.0	W. Cross st.....	Mt. Sterling ...	Brown.....
19.6	100	8.4	30	70.4	River rd.....	Hollis.....	Peoria.....
8.0	85	14.0	85	78.0	Tri-City.....	Stites.....	St. Clair.....
9.6	10	12.0	50	78.0	..do.....	..do.....	..do.....
5.2	75	7.6	75	87.2	..do.....	..do.....	..do.....
3.2	90	8.8	60	88.0	..do.....	..do.....	..do.....
8.0	90	10.0	70	82.0	Cairo-Mound City	Cairo.....	Alexander.....
8.8	60	8.4	90	82.8	W. Hurst st	Bushnell.....	McDonough ...
9.2	30	11.2	100	78.4	Cairo-Mound City	Cairo.....	Alexander.....
8.8	70	10.4	90	80.0	..do.....	..do.....	..do.....

EXPERIMENTAL ROAD WORK.

The following tables give lists of the applications received during 1910, 1911 and 1912 respectively, for experimental road construction:

TABLE NO. 22.

Applications for Experimental Road Work, 1910.

County.	Township.	Length of road—miles.
Bureau	Walnut	1
Cass	Road District No. 3	1
Crawford	Martin	1
Effingham	Douglas	½
Gallatin	Bowlesville	⅝
Grundy	Braceville	1½
Henry	Geneseo	1
Iroquois	Beaver	1
JoDaviess	Galena (City)	.....
Kankakee	Yellowhead	2
LaSalle	Earl	1
Lawrence	Bridgeport	1
Lee	China	½
Lee	Marion	½
Macoupin	Carlinville	1
McDonough	Mound	½
Madison	Edwardsville	¼
Madison	Nameoki	1
Marion	Salem	1
St. Clair	Lebanon	1
St. Clair	O'Fallon	1
Tazewell	Pekin	1
Whiteside	Mt. Pleasant	1

1911.

Cass	Road District No. 3	1
Cass	Road District No. 8 and 2	1
Clark	Casey	1
Cook	Northfield	1
Crawford	LaMotte	1½
Crawford	Robinson	1
DeKalb	Malta	2
Ford	Drummer	.....
Ford	Sullivant	1
Greene	Rubicon	1
Greene	Whitehall	1
Iroquois	Middleport	1
Kankakee	Ganeer	1
Kankakee	Momence	1

Applications for Experimental Road Work 1911—Continued.

County.	Township.	Length of road—miles.
Kankakee	Yellowhead	1
Lee	China	1
McLean	Bloomington	
McLean	Blue Mound	1
Madison	Collinsville	1
Madison	Jarvis	1
Mercer	New Boston	1
Pulaski	Road District No. 1	1
St. Clair	O'Fallon	1
Vermilion	Elwood	1
Whiteside	Mt. Pleasant	1

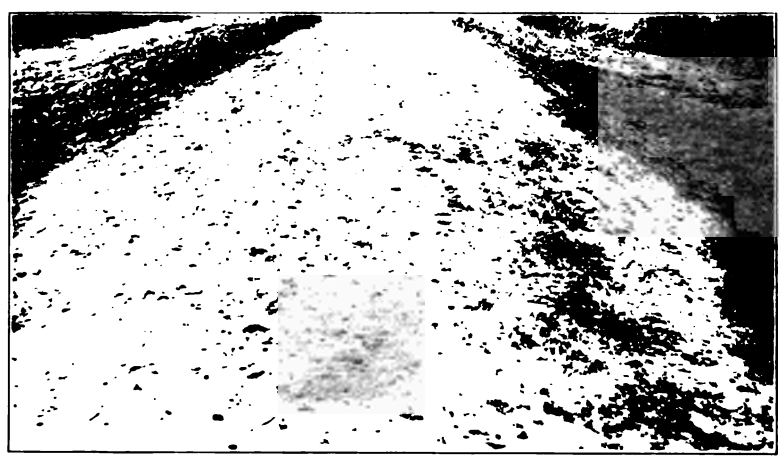
1912.

Adams	Honey Creek	1
Alexander	Road District No. 7	2½
Carroll	Rock Creek (Lanark)	1
Christian	Assumption	1
Clinton	Carlyle	1
Coles	Mattoon	1
Cook	Thornton	1
Crawford	LaMotte	1
DeKalb	Somonauk	1
Douglas	Bowdre	2
Douglas	Sargent	13
Effingham	Douglas	1
Hancock	Carthage	1
Jackson	Carbondale	5
Kendall	Seward	1
Lawrence	Bridgeport	2½
Lee	China	1
Logan	East Lincoln	1
McLean	Dale	2
McLean	Mt. Hope	1
Macoupin	Carlinville	1
Madison	Collinsville	1
Madison	Jarvis	1
Marion	Kinmundy	1
Ogle	Dement	1
Richland	Olney	1
Rock Island	South Moline	1
St. Clair	Mascoutah and Shiloh Valley	1
White	Carmi	1

EXTENT OF EXPERIMENTAL ROAD WORK.

During the six years that the Commission has been in existence, it has constructed 150 pieces of experimental road, aggregating a total of 1,001,823 square yards of new roads and 166,554 square yards of maintenance work. On a basis of a width of 12 feet, this is equivalent to 140 miles of new road and 23 miles maintained, or a total of 173 miles of road work. The amount of the various kinds of road and their cost are as follows:

A. Beardstown-Chandlerville road, Road District No. 3, Cass County, showing condition of road before improvement. Very sandy soil.



B. Beardstown-Chandlerville road, Road District No. 3, Cass County, showing road after being improved. Bituminous macadam, 10 feet wide. Built, 1911.

Kind of work.	Square yards.	Cost.
Waterbound macadam	651,123	$401,470 00
Bituminous macadam	288,971	222,142 00
Concrete	26,509	23,154 00
Waterbound resurfacing	58,281	4,227 00
Bituminous resurfacing	65,914	14,430 00
Bituminous surfacing of old macadam	42,359	6,384 00
Oiled earth	21,521	4,871 00
Brick pavement	13,699	20,293 00
Concrete curbs, inlets, drains, culverts, etc	.....	25,864 00
Total	1,168,377	$722,835 00

It should not be inferred that the maintenance work done was all that might have been required or might have been done on the 1,001,823 square yards of road constructed. It simply represents that which the Commission was called upon to do.

These roads have served a two-fold purpose; first to determine what modifications, if any, were necessary in the usual methods of macadam construction to adapt it to the soil and climatic conditions encountered in Illinois. In so far as they have served this purpose they have been in the strict engineering sense of the term, experimental roads. Second, they have served the more important purpose of demonstrating in various parts of the State, the economic value of improved highways and are in other words properly to be considered also as economic experiments which have been of great value to the various communities where they have been constructed.

The development of a sentiment in favor of improved highways in the State of Illinois as elsewhere, has been of slow but steady growth. It has been hampered by ignorance of the principles of highway improvement and its importance economically in a community, by lack of familiarity with the physical conditions of improved highways and the possibility of this form of construction on the types of soils to be found in Illinois, and with the climatic conditions encountered. As in other great economic movements, prejudice and conflicting interests have retarded the development of the sentiment. There has been noted, however, during the years of the operation of the Illinois Highway Commission, a steady growth of an intelligent interest in the subject, and throughout the State public spirited citizens have been studying the question and seeking information which would enable them to arrive at a conclusion in regard to the matter. These men have appreciated the fact that the best advertisement for a good road, and the best argument in its favor is a good road.

They have also appreciated the fact that the various questions raised locally in regard to the cost of construction, the durability of the road and similar questions, could best be answered by practical demonstrations in their community. The experimental road work of the Commission has offered an opportunity for them to secure such a demonstration at a minimum cost. Moreover, it has insured them that the road so constructed would be built in accordance with the best known principles of modern road construction.

For these experimental roads, the stone is furnished free on board the cars at the penitentiaries, the local officials paying only the freight

charges from the penitentiary to the place where the stone is used. The railroads throughout the State have granted a special rate on this material of one-half cent per ton mile, with a minimum of 25 cents per ton for each road handling the shipment. This has placed the crushed stone within the reach of a great many communities that would otherwise not have any road material accessible at a price which would permit them with the limited amount of money available, to construct the first few sections of road.

The State Highway Commission has furnished the machinery necessary for properly placing the crushed stone, paying the cost of the men who operated the steam rollers so that the local community was required to pay only the cost of coal, oil and similar supplies. In addition, the Commission has furnished an engineer trained in road work to superintend the construction, without cost to the local community. When in addition, the value of the crushed stone is considered, the contribution of the State towards the construction of these experimental roads has been the equivalent of one-fourth to one-half of the cost of the roads, and has very materially assisted communities in securing their first few miles of hard roads. It has been the usual experience in the State that any community which once constructed a few sections of hard roads, has added to the mileage from year to year until sentiment has developed to the point where it was possible to levy a considerable tax for this class of work.

The labor cost of the construction of the experimental roads has been paid by the local communities, in many cases the money being raised by private subscriptions, or at least, partially by subscription, the remainder being paid from township funds. In other cases, the entire labor cost was paid from township funds, but in all cases, the funds available for the construction were in the hands of the local officials and at their disposition. Thus the State Commission was asked to send men to take charge of a piece of work upon which the local people were spending their own money. Inasmuch as the men interested would often have definite ideas in regard to the manner of carrying on the work and were for the most part sincere in their opinions as to how things should be done, though often wrong, it has been no simple problem to construct sections of road in the various communities under these conditions, and in every case, secure the economy of construction and the efficiency in organization that might be desired.

Oftentimes conditions arose which seriously interfered with the efficiency of the construction, but which could not be changed without injustice to those who had given their efforts towards securing coöperation in the construction of a piece of road. In such a case, the best was made of local conditions and every attempt possible made to secure a satisfactory piece of construction, even though the cost might have been somewhat greater than it would have been under more favorable conditions. But there has been a noticeable improvement in conditions from year to year, and during the past season, there has been comparatively little difficulty to carry out the work practically as desired.

As the roads which are constructed will be used for many years, with small probability of a change in the grades, it has been the policy to keep

the grades to a minimum of 4 per cent, and where the road is slightly rolling, although no large hills were encountered, the grades have been established so as to do away with all of the unnecessary undulations in the road. Care also has been taken in laying out all of these roads to provide ample surface drainage for storm water.

Roads have been constructed of varying thicknesses, sometimes because the local officials felt that on account of the cheapness of the stone, it would be as well to use plenty of it, and sometimes it was desired to demonstrate the possibility of economical construction by reducing the thickness of the stone where local conditions would warrant. The thickness has varied from 5 inches to 12 inches, after being thoroughly compacted. Inspections made on these various roads from time to time, show conclusively that there is no soil encountered in Illinois, upon which it is necessary to use a thickness of crushed stone greater than 8 inches after being rolled and have also shown there are many types of sandy soil in the State upon which a layer of stone 6 inches thick will serve all purposes of traffic.

The width of roadway has also been varied considerably on the various sections of the road, the widths built being from 10 feet to 30 feet. Observations of these roads under traffic indicates that there are very few places in the State where a roadway 10 feet wide is sufficient. A road which does not have any large amount of traffic before improvement, will after improvement attract a great deal of traffic, and consequently require a wider road than seems to be necessary from the traffic observed before improvement.

It is also apparent that roads constructed in the vicinity of cities of from 10,000 population upwards, should be wider than 12 feet. This is particularly true if the road will be subjected to any considerable amount of motor traffic, as is often the case in the vicinity of a city. These roads should be at least 16 or 18 feet wide in order to accommodate both the motor and horse drawn traffic. While it may not seem desirable to build roads merely for motor traffic, yet it is evident that the motor traffic is here and must be taken into account in any comprehensive system of road improvement.

In general, it can be said that in most communities where it is worth while to construct and improve roadways at all, a width of 12 feet is desirable. And in many communities, the roadways must necessarily be 16 to 18 feet wide in order properly to accommodate the traffic which will use them. Moreover, the traffic census which has been taken by the Illinois Highway Commission during the past six years, shows that there is a large increase in motor traffic on these improved roads from year to year, and consequently a road which might be wide enough upon completion will be too narrow to accommodate the traffic in a few years.

The years 1910 and 1912 were about normal years so far as weather conditions affecting road constructions were concerned, and during those years, the supply of material was ample and in general promptly delivered except late in fall, so that no unusual delays were encountered, and the work was carried out with ordinary dispatch. The season of 1911 was an extremely unfavorable one for macadam construction, due to the

A. Bowlesville road, Shawnee Township, Gallatin County. Before improvement River bottom, clay road.

B. Bowlesville road, Shawnee Township, Gallatin County. After improvement with waterbound macadam. Built, 1910.

fact that the rains held late in the spring, and the fall was an unusually wet one. This was particularly disastrous to the work of the Commission during that season, because of bituminous macadam construction which was under way at the time when the weather was the worst.

On all experimental road work, the engineer in charge was required to make a daily report of cost and progress in accordance with detailed instructions which were given him at the beginning of the season, and the tables of cost which follow, are based upon the daily reports which have been submitted. In general, these reports have been checked against independent records of the cost of the road kept by local officials, and have been found to be in general accurate.

Along with the experimental road work there has been developed another phase of coöperation between the commission and township road officials. If a township has on hand sufficient funds for the construction of one or two miles of hard roads, and will advertise for bids on the work, it will be necessary for the contractor to place a large fixed charge against a comparatively small amount of construction work, and as a result the cost of the work to the township will be relatively large. Many townships have adopted the plan of building from one to two miles of permanent roads each year. They do not have the funds available for equipping themselves for the work, and therefore, must either do the work by contract or depend upon the use of the State outfits for it, and there has been an increasing number of townships that have asked for assistance from the State in the construction of their roads each year.

Where conditions are as have been outlined, that is, a comparatively small amount of money each year to be spent, it seems very desirable for the State Highway Commission to furnish the outfit for the construction. These outfits can be used throughout the season in various parts of the State so they can, therefore, be handled efficiently; they can be put in charge of trained men who are able to build high class roads at a reasonable cost, and the fixed charge and profit which a contractor must necessarily get, would be saved to the township. This sort of coöperation might not be desirable in a township building a number of miles of road each year, or on the construction of through roads, but on the construction of small sections of road widely scattered about the State, it is difficult to see how a more practical and efficient method of coöperation could be devised.

When Illinois is on a state aid basis in road construction, and the main traveled roads of the counties are being constructed by contract under some state aid plan, there will still be local roads and feeders to the main roads to construct. Some of these will be of sufficient length to make it advisable to build them by contract, but there will be a great many short pieces of road widely scattered about the State to be constructed, and it is probable that eventually the experimental road work as now conducted will be modified so as to meet the needs which will arise in taking care of these isolated sections of roads, and the methods now followed in the construction of experimental roads will, when applied to these roads, give in a measure State aid in their construction and still permit the local officials to build their roads as their means will permit.

TABLE NO. 23.

Cost for rolling on 1,022,159 square yards of experimental roads, 1908-1912—Machinery owned and operated by the Illinois Highway Commission.

Salary and expenses of roller operators	$27,593 00
Cost of maintenance of outfits	4,545 00
Freight on outfits	4,749 00
Total	$36,887 00

Cost per square yard for rolling.

Salary and expenses of operators	$0.0270
Maintenance of outfits	.0044
Freight on outfits	.0047
Total	$0.0361

TABLE NO. 24.

Cost of maintenance of experimental road outfits—Owned and operated by the Illinois Highway Commission, 1908-1912.

Amount of road built, square yards	1,022,159
Amount of bituminous macadam, square yards	397,244
Cost of eleven macadam outfits	$37,579 00
Cost of six bituminous outfits	6,628 00
Cost of two concrete outfits	5,381 00
Total	$49,588 00
Cost of maintenance of macadam outfits	$3,272 00
Cost of maintenance of bituminous outfits	1,273 00
Number of outfit seasons covered by maintenance charges on macadam outfits	52
Number of outfit seasons covered by maintenance charges on bituminous outfits	12
Cost per season per outfit for maintenance of macadam outfits	$ 61 80
Cost per season per outfit for maintenance of bituminous outfits	106 00
Cost per square yard for maintenance of macadam outfits	$0.003
Cost per square yard for maintenance of bituminous outfits	0.003

TABLE NO. 25.

Cost of engineering, supervision and inspection of experimental roads, 1908-1912.

Cost of work constructed	$650,183 00
Square yards of road constructed	1,055,501
Cost of 1,055,501 square yards of road	$624,319 00
Total cost of engineering, superintendence and inspection, including office expenses for all road work	$87,466 00
Less cost of engineering furnished on roads not built by the commission (25 miles at $50.00)	$1,250 00
Less cost of supervision of nonexperimetal roads using penitentiary stone	1,335 00
Total expense not chargeable to experimental roads	$2,585 00
Cost of engineering and supervision on experimental roads	$84,881 00
Percentage of total cost of experimental roads expended for engineering superintendence and inspection, per cent	13
Cost per square yard finished road for engineering, supervision and inspection	$0.059

EXPERIMENTAL ROADS CONSTRUCTED IN 1910.

WALNUT.

CEMETERY ROAD, WALNUT TOWNSHIP, BUREAU COUNTY.

The Cemetery road leads in a westerly direction from the city of Walnut over rolling country. A considerable amount of earth work was done in order to reduce the grades on two of the hills. A part of the road was over low ground, and on these sections the roadway was raised and widened. The soil is a black sandy loam. The macadam was made 12 feet wide and 6 inches thick, except on the new fills where the thickness of stone was increased to 8 inches. Stone for the improvement was furnished from the penitentiary at Joliet, and was hauled directly from the cars, except for five cars which were hauled from a storage pile. The work was paid from township funds. The surface was bonded with Joliet screenings, then covered with sandy loam.

The following table gives the itemized cost of the work:

Length of road	5,300	feet
Width of macadam	12	feet
Macadam laid	7,033	sq. yds.
Stone in road	1,930	cu. yds.
Stone hauled from cars	1,750	cu. yds.
Stone hauled from storage pile	180	cu. yds.
Average haul of stone	¾	mile

Rate of pay: Men, 20 cents; teams, 40 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 120.00
Excavation	589.00
Shaping road bed	16.00
Loading stone	171.00
Hauling stone, including rehandling	796.80
Spreading stone	125.00
Trimming shoulders and side roads	140.00
Rolling and sprinkling	73.00
Watchman and miscellaneous labor	63.50
Coal, oil and supplies	65.28
Gravel binder delivered	24.00
Freight on stone and car service	1,625.26
Total	$3,808.84

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone	$0.0886
Hauling stone, including rehandling	.4160
Spreading stone	.0646
Rolling and sprinkling	.0378
Watchman and miscellaneous labor	.0328
Coal, oil and supplies	.0339
Total	$0.6737

Bridgeport street road, Whitehall Township, Greene County. Waterbound macadam, 12 feet wide. Built, 1912.

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.0176
Excavation	.0838
Shaping road bed	.0022
Trimming shoulders and side roads	.0199
Placing stone	.1842
Gravel binder	.0034
Freight on stone	.2310
Total	$0.5421

Beardstown.

BEARDSTOWN-VIRGINIA ROAD, ROAD DISTRICT NO. 3, CASS COUNTY.

The Beardstown-Virginia road begins at the city limits of the city of Beardstown and is a continuation of Wall street. The portion improved extends in an easterly direction for a distance of about 1½ miles. The soil upon which the road is constructed is very sandy, but was well shaped so that only a small amount of earth work was done. On account of the nature of the soil, it was thought advisable to make the thickness of the macadam 7 inches. The macadam is 12 feet wide. One section of the road is bituminous macadam, and the other water-bound macadam. Stone for the improvement was furnished from the penitentiary at Joliet, and was shipped in and unloaded before the work began. The funds for the improvement were provided in part by the county commissioners, in part by the district highway commissioners, and in part by a subscription raised among the business men of Beardstown.

Asphalt macadam construction.

Four sizes of stone were used in the asphalt macadam construction as follows: 3-inch stone, 2-inch stone, ¾-inch chips free of dust and screenings passing through a ¼-inch screen.

The stone was spread in two courses; the lower course being 4 inches thick after rolling, and the upper course being 3 inches thick after rolling. The lower course was of 2-inch stone and the upper course of 3-inch stone. The lower course was spread, harrowed, rolled and bonded with a mixture of screenings, and the sandy loam found along the road. The top course was rolled and partially filled with chips to fill the surface interstices, and then the asphalt poured into the surface, one application only being made. After the asphalt was spread, it was covered with chips and opened to traffic. The bituminous binder was purchased in tank cars and heated in the cars by means of steam coils, then hauled to the road and applied with hand-spreading cans. It was found, however, that the material could not be heated sufficiently by this method to penetrate the upper layer of stone and that it could not be spread uniformly by means of hand pouring. Bituminous binder No. 128 was used.

Waterbound macadam construction.

The stone on the waterbound section was spread in two approximately equal layers 4 inches thick before rolling, and was thoroughly rolled and bonded with water and a mixture of screenings and sandy loam.

The following itemized statement is a report on the cost of the two classes of construction:

Length of road	7,240 feet
Width of macadam	12 feet
Macadam laid	9,653 sq. yds.
Stone in road	2,530 cu. yds.
Stone hauled from cars	230 cu. yds.
Stone hauled from storage	2,300 cu. yds.
Average haul of stone	1½ miles
Surface treated with bituminous binder	7,292 sq. yds.
Bituminous binder used	13,579 gallons
Average haul of tank wagon	1½ miles

Rate of pay: Men, 20-25 cents; teams, 35-40 cents per hour; spreading binder, men, 25 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 147.00
Excavation	188.85
Shaping road bed	151.50
Loading stone	241.50
Hauling stone, including rehandling	1,113.45
Spreading stone	255.50
Trimming shoulders and side roads	139.50
Rolling and sprinkling	137.60
Watchman and miscellaneous labor	42.50
Coal, oil and supplies	87.29
Heating bituminous binder	60.00
Hauling and spreading bituminous binder	114.15
Cost of 13,579 gallons bituminous binder delivered	524.15
Freight on stone	2,308.10
Total	$5,511.12

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone	$0.0954
Hauling stone, including rehandling	.4470
Spreading stone	.1009
Rolling and sprinkling	.0543
Watchman and miscellaneous labor	.0168
Coal, oil and supplies	.0345
Total	$0.7489

COST PER GALLON FOR APPLYING BINDER.

Heating	$0.0044
Hauling and spreading	.0084
Total	$0.0128

COST PER SQUARE YARD FINISHED WATERBOUND MACADAM.

Superintendence	$0.0152
Excavation	.0195
Shaping road bed	.0156
Trimming shoulders and side roads	.0144
Placing stone	.1965
Freight on stone	.2391
Total	$0.5003

COST PER SQUARE YARD FINISHED BITUMINOUS MACADAM.

Superintendence	$0.0152
Excavation	.0195
Shaping road bed	.0156
Trimming shoulders and side roads	.0144
Placing stone	.1965
Applying bituminous binder	.0238
Cost of bituminous binder	.0718
Freight on stone	.2391
Total	$0.5959

EFFINGHAM.

FAYETTE AVENUE ROAD, DOUGLAS TOWNSHIP, EFFINGHAM COUNTY.

The Fayette avenue experimental road began at the west end of the paving on Fayette avenue in the city of Effingham, and extends in a westerly direction for a distance of ¾ mile. The soil is a light clay which readily absorbs and retains water. The country is somewhat rolling, and consequently well drained. At one place the road is crossed by a deep ravine, necessitating the lengthening of the existing culvert, and the widening of the roadway. Funds for the work were provided by the township commissioners from a portion of the regular road tax set aside for the purpose.

The following table is an itemized statement of the cost of this work:

Length of road	3,960 feet
Width of macadam	12 feet
Macadam laid	5,280 sq. yds.
Stone in road	1,890 cu. yds.
Stone hauled from cars	1,390 cu. yds.
Stone hauled from storage pile	500 cu. yds.
Average haul of stone	¾ mile

Rate of pay: Men, 17½ cents; teams, 45 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 112.00
Excavation	70.85
Shaping road bed	25.62
Loading stone	40.68
Hauling stone, including rehandling	325.18
Spreading stone	152.43
Trimming shoulders and side roads	54.41
Rolling and sprinkling	91.10
Watchman and miscellaneous labor	99.79
Coal, oil and supplies	68.25
Freight on stone and car service	1,908.26
Total	$2,948.57

A. West Side road, Middleport Township, Iroquois County. Before improvement. Sandy soil.

B. West Side road, Middleport Township, Iroquois County. After improvement with waterbound macadam. Built, 1912.

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone	$0.0215
Hauling stone, including rehandling	.1720
Spreading stone	.0806
Rolling and sprinkling	.0490
Watchman and miscellaneous labor	.0526
Coal, oil and supplies	.0360
Total	$0.4117

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.02121
Excavation	.01341
Shaping road bed	.00485
Trimming shoulders and side roads	.01034
Placing stone	.14723
Freight on stone	.36130
Total	$0.55834

PAXTON.

PELL STREET ROAD, PATTON TOWNSHIP, FORD COUNTY.

The Paxton work was tar macadam construction. The soil upon which the road was built is black loam and is fairly well underdrained. Stone for the improvement was furnished from the penitentiary at Joliet and the work done was paid from funds provided by the city of Paxton. Most of the grading was done before the State Commission took charge of the construction as well as the concrete curb and gutter which was laid under the supervision of the city engineer of Paxton. Subsequent to the completion of the work originally contemplated, an additional section was laid which was waterbound macadam construction 4 inches thick on a road having very light traffic.

Tar macadam construction.

Four sizes of stone were used on the tar work as follows: 3-inch stone, 2-inch stone, ¾-inch chips free from dust, and screenings which would pass through a ¼-inch screen. The stone was placed in two layers, having a total thickness of 9 inches at the crown and 6 inches at the curb, the upper course being 2½ inches thick. The lower course on all except two blocks of the work was made of 3-inch stone, which was spread, harrowed, rolled and bonded with screenings and water. On the other two blocks the 2-inch stone was used for the lower course and harrowed, rolled and bonded with screenings and water, and 3-inch stone was used for the upper course of stone which was made about 3 inches thick after rolling. It was rolled thoroughly and the surface voids filled with ¾-inch chips before any bituminous binder was applied. On the remainder of the road where 2-inch stone was used for the surface, no chips were put on until after one course of tar binder had been

spread. The tar was applied in two courses, the first of which was about 1½ gallons per square yard, and the second about ½ gallon per square yard. The tar binder was applied by spraying from a specially constructed nozzle, which gave a fairly uniform distribution of the material. After the first tar application had been made, the surface was smoothed with a roller and covered with ¾-inch chips, which were broomed into and filled all the voids in the surface. Chips were then brushed in and the second course of bituminous binder, amounting to ½ gallon per square yard of surface, was spread and rolled, and the surface again covered with chips. Tar binders Nos. 122 and 120 were used.

Waterbound macadam construction.

For this work the stone was spread 5 inches thick at the crown and 4 inches at the shoulder and was thoroughly rolled, filled with screenings and bonded with water.

The following tables are itemized statements of the cost of the two classes of work on this road:

Length of road.....460 feet-26.5 feet; 2,800 feet-16 feet; 3,100 feet-20 feet
Width of macadam.....16 feet, 20 feet and 26.5 feet
Macadam laid.....13,534 sq. yds.
Stone in road..... 2,174 cu. yds.
Stone hauled from cars..... 1,074 cu. yds.
Stone hauled from storage..... 1,100 cu. yds.
Average haul of stone..... ½ mile
Surface treated with bituminous binder..... 8,420 sq. yds.
Bituminous binder used.....16,000 gallons
Average haul of tank wagon..... ½ mile
Rate of pay: Men, 20 cents; teams, 40 cents per hour; spreading binder, men, 20 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 169.75
Shaping road bed	216.20
Loading stone	179.30
Hauling stone, including rehandling	1,002.90
Spreading stone	277.70
Rolling and sprinkling	156.20
Watchman and miscellaneous labor	31.20
Coal, oil and supplies	71.45
Heating bituminous binder	126.00
Hauling and spreading bituminous binder	36.20
Cost of bituminous binder	1,040.00
Freight on stone	2,614.24
Total	$5,921.14

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone	$0.0824
Hauling stone, including rehandling	.4610
Spreading stone	.1276
Rolling and sprinkling	.0718
Watchman and miscellaneous labor	.0143
Coal, oil and supplies	.0328
Total	$0.7899

COST PER GALLON FOR APPLYING BINDER.

Heating	$0.00786
Hauling and spreading	.00226
Total	$0.01012

COST PER SQUARE YARD FINISHED WATERBOUND MACADAM.

Superintendence	$0.0122
Shaping road bed	.0160
Placing stone	.1271
Total	$0.1553

COST PER SQUARE YARD FINISHED BITUMINOUS MACADAM.

Superintendence	$0.0122
Shaping road bed	.0160
Placing stone	.1271
Applying bituminous binder	.0192
Cost of bituminous binder	.1235
Freight on stone	.3104
Total	$0.6084

DONOVAN.

EAST MAIN ROAD, BEAVER TOWNSHIP, IROQUOIS COUNTY.

Main street road was constructed on black soil, some sections of which were sandy. It extends through a fairly level country, and only a small amount of grading was necessary. Stone for the improvement was furnished from the penitentiary at Joliet, and was shipped in and unloaded before the work began. The funds used in paying for the work were provided from the regular road and bridge tax of Beaver Township. The road begins at the Big Four railroad on the main street in Donovan, and extends along the main street of Donovan to the village limits, and thence in an easterly direction into the township, a total distance of about 1½ miles. The macadam was made 12 feet wide and 8 inches thick. The stone was placed in two approximately equal courses, the 3-inch stone being used for the upper course and the 2-inch stone for the lower course. The upper course was bonded with a mixture of the Joliet limestone screenings and screenings obtained from Kankakee quarries.

The following tables give itemized cost of this work:

Length of road: 50 feet-22 feet; 290 feet-160 feet; 54 feet-42 feet; 5,200 feet-12 feet, and 2,700 feet-11 feet.

Macadam laid	15,763 sq. yds.
Stone in road	4,200 cu. yds.
Stone hauled from cars	1,816 cu. yds.
Stone hauled from storage pile	2,384 cu. yds.
Average haul of stone	½ mile

Rate of pay: Men, 20 cents; teams, 35-40 cents per hour.

A. Carterville road, Carbondale Township, Jackson County. Before improvement. Clay soil.

B. Carbondale-Carterville road, Carbondale Township, Jackson County, showing road after improvement. Waterbound macadam, 14 feet wide. Built, 1912.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 231.00
Excavation	645.06
Shaping road bed	271.50
Loading stone	414.40
Hauling stone, including rehandling	1,133.80
Spreading stone	361.00
Trimming shoulders and side roads	121.37
Rolling and sprinkling	133.50
Watchman and miscellaneous labor	66.90
Coal, oil and supplies	198.67
Freight on stone and car service	3,014.97
Total	$6,592.17

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone	$0.0987
Hauling stone, including rehandling	.2697
Spreading stone	.0860
Rolling and sprinkling	.0318
Watchman and miscellaneous labor	.0159
Coal, oil and supplies	.0473
Total	$0.5494

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.014654
Excavation	.040922
Shaping road bed	.017220
Trimming shoulders and side roads	.007690
Placing stone	.146400
Freight on stone	.191200
Total	$0.418086

JERSEYVILLE.

EXTENSION OF THE FIELDON ROAD IN THE CITY OF JERSEYVILLE, JERSEY COUNTY, ILLINOIS.

Previous work done on the Fieldon road in Jersey Township brought the completed macadam to the city limits of Jerseyville. Inside the city limits there was one-quarter of a mile of unimproved earth road over which all traffic on the Fieldon road must pass before reaching the macadam streets of the city. This one-quarter mile section was finally improved by the city of Jerseyville with a macadam roadway similar in all respects to that built on the Fieldon road and the construction was carried out in the same manner as described in the third report of the State Highway Commission.

The following table is an itemized statement of the cost of this work:

Length of macadam	1,320 feet
Width of macadam	12 feet
Macadam laid	1,760 sq. yds.
Amount of stone in road	612 cu. yds.
Amount of stone hauled from cars	149 cu. yds.
Amount of stone hauled from storage pile	463 cu. yds.
Length of haul	1½ mile

Rate of pay: Men, 20 cents; teams, 30 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 87.00
Shaping road bed	85.20
Loading and hauling stone, including rehandling	268.82
Spreading stone	94.40
Trimming shoulders and side roads	11.76
Rolling and sprinkling	75.46
Coal, oil and supplies	14.81
Watchman and miscellaneous labor	63.31
Freight on stone	460.38
Total	$1,161.14

COST PER CUBIC YARD FOR PLACING STONE.

Loading and hauling stone, including rehandling	$0.43957
Spreading stone	.15424
Rolling and sprinkling	.12330
Watchman and miscellaneous labor	.10344
Coal, oil and supplies	.02419
Total	$0.84479

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.04943
Shaping road bed	.04830
Trimming shoulders and side roads	.00668
Placing stone	.29363
Freight on stone	.26157
Total	$0.65961

Grant Park.

CHICAGO-VINCENNES ROAD, YELLOWHEAD TOWNSHIP, KANKAKEE COUNTY.

The work done on the Chicago-Vincennes road is a continuation of the work done by the State Highway Commission at Grant Park in 1909, on the road known as Bailey's Lane. The work done in 1910 was done under the immediate supervision of Chas. Hayden, commissioner of Yellowhead Township, under the instructions of the State Engineer. The stone for the improvement was furnished from the penitentiary at Joliet and the machinery was furnished by the Illinois Highway Commission.

The soil is black loam, and the country somewhat rolling, but only a small amount of grading was necessary. The macadam was made 10 feet wide and 8 inches thick after rolling, and bonded with screenings and brick dust. The work was paid from funds raised by the township by means of a special levy for the purpose.

The following table gives an itemized statement of the cost of this work:

Length of road	5,330 feet
Width of macadam	10 feet
Macadam laid	5,922 sq. yds.
Stone in road	2,120 cu. yds.
Average haul of stone	¾ mile

Rate of pay: Men, 20 cents; teams, 40 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 187.89
Loading stone and dumping wagons	538.77
Hauling stone, including spreading same	849.17
Rolling and sprinkling	118.08
Watchman and miscellaneous labor	175.37
Coal, oil and supplies	95.20
Freight on stone and car service	1,325.04
Total	$3,289.52

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone and unloading	$0.254
Hauling and spreading stone	.405
Rolling and sprinkling	.055
Watchman and miscellaneous labor	.082
Coal, oil and supplies	.045
Total	$0.841

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.0318
Placing stone	.3000
Freight on stone	.2239
Total	$0.5557

SOLLITT.

EAST AND WEST MAIN ROAD, YELLOWHEAD TOWNSHIP, KANKAKEE COUNTY.

The Sollitt road is the main east and west road through the village of Sollitt, and the road was improved for about a mile, one-half being east and one-half west of the village.

The work at Sollitt was done under the direction of Chas. Hayden, commissioner of Yellowhead Township, in accordance with the general instructions of the State Engineer. The stone was purchased from Thornton and the machinery for doing the work was furnished by the State Highway Commission. The road is practically level and only a small amount of grading was necessary. The soil is black loam. The macadam was made 10 feet wide and 8 inches thick finished, and was bonded with screenings.

The following table is an itemized statement of the cost of this work.

Length of road	5,800 feet
Width of macadam	10 feet
Macadam laid	5,866 sq. yds.
Stone in road	1,780 cu. yds.
Average haul of stone	¼ mile

Rate of pay: Men, 20 cents; teams, 40 cents per hour.

A. Grove street road, Mt. Pleasant Township, Whiteside County. Asphalt macadam. Built, 1911.

B. Fieldon road, Jerseyville Township, Jersey County. Macadam with coating of heavy asphalt. Road built, 1909; surfaced with asphalt, 1912.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 165.28
Loading and unloading stone	465.52
Hauling and spreading stone	512.90
Rolling and sprinkling	118.93
Watchman and miscellaneous labor	128.03
Coal, oil and supplies	40.41
Gravel binder delivered	7.70
Stone and freight on stone and car service	1,740.86
Total	$3,179.63

COST PER CUBIC YARD FOR PLACING STONE.

Loading and unloading stone	$0.261
Hauling and spreading stone, including rehandling	.289
Rolling and sprinkling	.0668
Watchman and miscellaneous labor	.0719
Coal, oil and supplies	.0227
Total	$0.7114

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.0281
Placing stone	.2159
Gravel binder	.0013
Stone and freight on same	.2967
Total	$0.5420

EARLVILLE.

CEMETERY ROAD, EARL TOWNSHIP, LA SALLE COUNTY.

The Cemetery road begins at the south corporation line of the city of Earlville, and extends south and then east, the total length improved being about 7,000 feet. The existing road was a badly worn gravel, and a six-inch course of crushed stone, 12 feet wide, was placed on top of the old surface. The new road was bonded with Joliet screenings and then dressed with gravel, a part of which was obtained from a local pit, and a part from the Spring Valley gravel pit. A considerable part of the stone was placed by the commissioners under instructions from the State Engineer before the outfit arrived.

Stone for the improvement was furnished from the penitentiary at Joliet, and the cost of the improvement was paid from township funds. The commissioners handled a large part of the work with only occasional inspections from the State, and did the work in a very satisfactory and economical manner.

The following table is an itemized statement of the cost of this work:

Length of macadam	7,127 feet
Width of macadam	12 feet
Macadam laid	9,502 sq. yds.
Amount of stone in road	2,351 cu. yds.

Amount of stone hauled from cars	2,000 cu. yds.
Amount of stone hauled from storage pile	351 cu. yds.
Average haul of stone	1½ miles

Rate of pay: Men, 20 cents; teams, 40 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 108.80
Excavation	197.20
Shaping road bed	14.00
Loading stone on wagons	50.20
Hauling stone, including rehandling	1,089.90
Spreading stone	49.30
Trimming shoulders and side roads	31.00
Rolling and sprinkling	322.50
Coal, oil and supplies	68.80
Applying gravel binder	50.60
Cost of 209.4 yards gravel delivered	634.08
Watchman and miscellaneous labor	59.00
Freight on stone	1,618.49
Total	$4,293.87

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone on wagons	$0.02135
Hauling stone, including rehandling	.46371
Spreading stone	.02097
Rolling and sprinkling	.13717
Watchman and miscellaneous labor	.02509
Coal, oil and supplies	.02926
Total	$0.69755

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.01145
Excavation	.02075
Shaping road bed	.00147
Trimming shoulders and side roads	.00326
Placing stone	.17256
Applying gravel binder, including cost of binder	.07205
Freight on stone	.17033
Total	$0.45187

BRIDGEPORT.

BRIDGEPORT-SUMNER ROAD, BRIDGEPORT TOWNSHIP, LAWRENCE COUNTY.

Work began on this road near the westerly limit of the city of Bridgeport on the Bridgeport and Sumner township road and extended in a westerly direction about one mile. The country is rolling and a large amount of grading was necessary in order to construct a satisfactory road. Most of the grading was done by the township commissioners previous to the commencement of the State experimental work. The soil is a red clay. This road is in the oil fields and is subjected to a large amount of very heavy traffic. Stone for the improvement was fur-

nished from the penitentiary at Chester, and a part of it was shipped in and unloaded before the actual construction began. The macadam was made 12 feet wide and 8 inches thick, and bonded with screenings. The funds for the work were provided by a special tax voted by Bridgeport township. On account of local conditions at Bridgeport, labor is high and working conditions were not the most satisfactory, and as a result the cost was greater than for similar work in many other sections of the State.

The following table gives an itemized cost of the work:

Length of macadam	5,280 feet
Width of macadam	12 feet
Macadam laid	7,040 sq. yds.
Amount of stone in road	1,916 cu. yds.
Amount of stone hauled from storage pile	1,916 cu. yds.
Average haul of stone	¾ mile

Rate of pay: Men, 25 cents; teams, 50 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 81.00
Excavation	1,527.04
Shaping road bed	134.50
Loading stone on wagons	192.81
Hauling stone, including rehandling	555.65
Spreading stone	190.62
Trimming shoulders and side roads	116.53
Rolling and sprinkling	54.70
Coal, oil and supplies	54.75
Watchman and miscellaneous labor	116.53
Freight on stone	1,585.54
Total	$4,609.67

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone on wagons	$0.10063
Hauling stone, including rehandling	.23823
Spreading stone	.09948
Rolling and sprinkling	.02854
Watchman and miscellaneous labor	.06082
Coal, oil and supplies	.02856
Total	$0.55626

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.01150
Excavation	.21690
Shaping road bed	.01910
Trimming shoulders and side roads	.01655
Placing stone	.16562
Freight on stone	.22521
Total	$0.65488

A. Range street road, Momence-Ganeer Townships, Kankakee County, before improvement.

B. Range street road, Momence-Ganeer Townships, Kankakee County, after improvement. Bituminous macadam, 16 feet wide.

Franklin Grove.

OREGON AND AMBOY ROADS, CHINA TOWNSHIP, LEE COUNTY.

Two sections of road were constructed at Franklin Grove, one an extension of macadam work done by the local commissioners on the Franklin Grove and Oregon main road, and the other an extension of macadam work done on the Franklin Grove and Amboy road.

Stone for the improvement was furnished from the penitentiary at Joliet, and the stone was hauled and placed by the local township commissioners, who received only occasional inspections from the State Commission. The macadam was made 12 feet wide and 8 inches thick. The machinery for placing the stone was furnished by the State Highway Commission. On account of the failure of the local commissioners to appreciate fully the importance of some of the instructions given them, the work was not entirely satisfactory to the commission. However, very serviceable roads were constructed at a comparatively small cost.

The following table is a general statement of the cost of this construction:

Length of macadam	3,960 feet
Width of macadam	12 feet
Macadam laid	5,280 sq. yds.
Amount of stone in road	1,915 cu. yds.
Amount of stone hauled from cars	1,915 cu. yds.
Average haul of stone	1 mile

Rate of pay: Men, 20 cents; teams, 40 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 93.00
Shaping road bed	307.00
Spreading and hauling stone, including rehandling	1,476.32
Trimming shoulders and side roads	260.00
Rolling and sprinkling	76.50
Coal, oil and supplies	42.10
Cost of Bellwood binder f. o. b. Franklin Grove	304.82
Freight on stone	1,143.90
Total	$3,703.64

COST PER CUBIC YARD FOR PLACING STONE.

Spreading and hauling stone, including rehandling	$0.77092
Rolling and sprinkling	.03995
Coal, oil and supplies	.02198
Total	$0.83285

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.01780
Shaping road bed	.05812
Trimming shoulders and side roads	.04924
Placing stone	.30206
Applying Bellwood screenings, including cost of binder	.05773
Freight on stone	.21664
Total	$0.70159

COLLINSVILLE.

COLLINSVILLE-EAST ST. LOUIS ROAD, COLLINSVILLE TOWNSHIP, MADISON COUNTY.

The improvement of a section of the road between Collinsville and East St. Louis presented somewhat unusual conditions, which required special treatment, somewhat out of the ordinary.

The stretch of road improved, about one mile in length extends from the higher level land to the lower country adjoining the Mississippi bottom lands. Along the line of bluffs dividing the high and low lands are found ridges of loose soil, very fine grained, siliceous material, having rather remarkable and, to the engineer who has to deal with it, aggravating properties. A high bank of this soil will stand with a vertical wall for years, but a small stream of water will cut in an hour or so a trench a number of feet deep. A newly made fill of this soil seems to offer no resistance whatever to the action of water, which will cut through and under it in a most surprising fashion.

On this road the grades, through the bluffs composed of this loess earth were 7 per cent which on account of a water main were not materially changed. Some appreciation of the erratic conditions that were encountered will be had from the accompanying photographs, which show a portion of the road before improvement. A summer shower would scour ruts and holes in the middle of the road two and three feet deep, so that it was always a question of some doubt whether the hill could be traveled in safety after a hard rain. But what was more puzzling was the drainage system that the water from the high banks had made. When those banks were cut into, water holes were found 15 to 25 feet deep and a number of feet in diameter, down which water poured, only to reappear at the surface at some unexpected place. If one of the outlets were closed, the water would burst out at some other point.

On either side of the road on the hill section, gullies had been scoured from four to eight feet deep. Thus it was clear that merely to macadamize the center of the road, with gutters provided in the usual way, would be but to invite sure disaster.

The following plan of procedure was adopted: Contrary to the usual practice, it was decided to attract all the drainage water possible to the road and keep it there. The essential thing to do, as the drainage conditions made clear, was to have a definitely known channel for all water that could find its way to the road. The cross section of the road shows the broad concrete gutters into which the water was to be guided. To get the water into the gutters and keep it from under the road, wing dams extending at right angles to the road were built across the gullies on either side for a depth of two or three feet below the bottom of the gulley and extending well back into the banks. The outer end of the dams is a foot or so higher than the end adjacent to the gutter. Where a wing dam joined the gutter, it was turned at right angles up the hill for about eight or ten feet, running parallel with the

outer edge of the gutter and flush with it. The first dam was built near the top of the hill and the next one placed so that its top would be about level with the bottom of the one above it. Thus, if the bank washed away or the ditch should scour, it would fill back of a dam level with its top and the water flowing in the ditch be distributed by the dam to the concrete gutter where it could do no further injury.

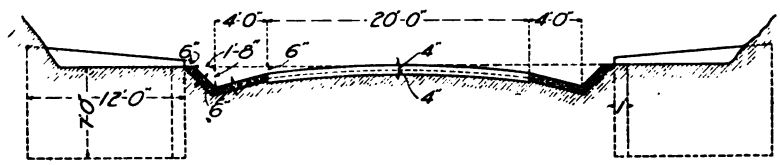


FIG. 6. Cross section of Collinsville-St. Louis road. Note concrete gutters and wing dams.

The construction of the road was begun at the top of the hill and worked downward. From the high banks, material was obtained to widen the road and to fill the gullies. On the roadbed, graded in the usual manner, the stone was spread in two layers. The gutters were laid contiguously with the roadway and rolled, except the outer edge, which was tamped. A board served to keep the screenings from filling the gutter. After the screenings were rolled, the gutter was poured with cement grout made one to three. The outer edge of the gutter was kept in line with a piece of two by four held by stakes.

So long as the weather remained fair, all went well, but as soon as a shower occurred, nearly all the unfinished portion of the macadam would be practically lost. The work was, therefore, kept finished as closely as possible, but in spite of all precautions it happened, owing to the frequent rains, that not less than 25 per cent of the work had to be done twice. The details of the construction are illustrated by accompanying cuts and diagrams.

The work was all done by day labor under the charge of J. G. Kalbfleisch, supervisor of Collinsville township. The rock was furnished f. o. b. at the Menard prison.

The following are the cost items which are not considered excessive when the difficulties encountered during the construction are considered. That the cost was not much greater is due to the excellent management of those in immediate charge of the work:

Length of road	5,520 feet
Width of macadam, 1,680 ft.-20 ft. wide; 3,840 ft.-16 feet wide.	
Macadam laid	10,560 sq. yds.
Stone in road	3,667 cu. yds.
Stone used for concrete walls and gutters	316 cu. yds.
Stone hauled from storage pile	2,500 cu. yds.
Stone hauled from cars	1,583 cu. yds.
Cubic yards of concrete in walls, etc	67
Lineal feet of grouted gutter, 5 feet wide	3,360
Average haul of stone	2 miles
Contract price for stone hauling	$0.75 per ton
Rate of pay: Men, 20 cents; teams, 50 cents per hour.	

A. West side road, Indian Grove Township, Livingston County, showing road before improvement.

West side road, Indian Grove Township, Livingston County, showing road after improvement. Waterbound macadam, 16 feet wide.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 395.50
Excavation	984.25
Shaping road bed	95.45
Unloading stone to storage pile	533.10
Hauling stone, including reloading	2,446.30
Spreading stone	346.50
Trimming shoulders and side roads	82.75
Rolling and sprinkling	386.00
Watchman and miscellaneous labor	240.30
Coal, oil and supplies	105.40
Freight on stone	3,202.64
Cement	449.13
Lumber for forms	19.00
Tile	22.25
Sand for concrete work	104.24
Mixing and placing grout for concrete	572.35
Total	$9,985.16

COST OF GROUTED GUTTER PER LINEAL FOOT.

Average width, 6 feet; thickness, 6 inches.

Length of gutter	3,360 feet
252 yards stone @ $1.55 on road	$390 00
Cement and sand	457.85
Mixing and placing grouting	476.95
Total	$1,324.80
Cost per foot	$0.39½

COST OF PLAIN CONCRETE WORK.

Total cubic yards placed	64
64 cubic yards stone @ $1.55	$99.20
Cement and sand	91.53
Mixing and placing	95.40
Total	$286.13
Cost per cubic yard	$4.45

COST PER CUBIC YARD FOR PLACING STONE.

Unloading stone from cars to storage pile	$0.213
Hauling stone, including reloading	.664
Spreading stone	.095
Rolling and sprinkling	.105
Watchman and miscellaneous labor	.062
Coal, oil and supplies	.028
Total	$1.167

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.0374
Excavation	.0930
Shaping road bed	.0090
Trimming shoulders and side roads	.0078
Placing stone	.3830
Freight on stone	.3050
Total	$0.8352

EDWARDSVILLE.

EDWARDSVILLE-ST. LOUIS ROAD, EDWARDSVILLE TOWNSHIP, MADISON COUNTY.

The St. Louis road begins at the end of West street in the city of Edwardsville and extends in a southerly direction for one-half mile. At the south end of the road is a hill (known locally as the Tanyard hill), which had a grade of approximately 11 per cent and it was decided to reduce the grade on the hill to a maximum of 7 per cent. This involved about 3,000 cubic yards of excavation, which was done by contract at a cost of $1,200.00. On account of the nature of the soil, considerable erosion had taken place in the ditches of the old road, and when the macadam was placed, a grouted concrete gutter was provided along the edges to carry the storm water and to prevent erosion in the future.

Aside from the special work on the Tanyard hill, the road presented no unusual construction problems. The soil is a reddish clay which absorbs and retains water, but drainage was easily provided.

The macadam was made 16 feet wide from West street to the entrance of the Banner Brick Company's plant, thence 12 feet wide to the foot of the Tanyard hill, and 16 feet wide between the gutters on the hill. Stone for the improvement was furnished from the penitentiary at Menard, and the cost of the improvement was paid from township funds.

The following table is an itemized statement of the cost of this work:

Length of macadam	4,500 feet
Width of macadam, 3,500 ft.-16 ft. wide; 1,000 ft.-12 ft. wide.	
Macadam laid	7,555 sq. yds.
Amount of stone in road	2,014 cu. yds.
Amount of stone hauled from cars	660 cu. yds.
Amount of stone hauled from storage pile	1,354 cu. yds.
Average haul of stone	1¼ miles
Rate of pay: Men, 20 cents; teams, 40 cents per hour.	

COST OF LABOR AND SUPPLIES.

Superintendence	$ 171.52
Excavation	1,286.11
Shaping road bed	195.42
Loading stone on wagons	251.58
Hauling stone, including rehandling	899.99
Spreading stone	118.72
Trimming shoulders and side roads	79.85
Rolling and sprinkling	197.50
Coal, oil and supplies	42.90
Watchman and miscellaneous labor	57.64
Freight on stone	1,450.43
Total	$4,751.66

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone on wagons	$0.12491
Hauling stone, including rehandling	.44686
Spreading stone	.05894
Rolling and sprinkling	.09806
Watchman and miscellaneous labor	.02861
Coal, oil and supplies	.02130
Total	$0.77868

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.02270
Excavation (average 46 cu. yds. per sq. yd. surface)	.17023
Shaping road bed	.02586
Trimming shoulders and side roads	.01056
Placing stone	.20758
Freight on stone	.19198
Total	$0.62891
Cost of 1,490 feet concrete curb and gutter	$375.66

NAMEOKI.

SECTION OF COLLINSVILLE-EAST ST. LOUIS ROAD, NAMEOKI TOWNSHIP, MADISON COUNTY.

This section of road was constructed on a part of the main road between Collinsville and East St. Louis in the American bottoms, and is an extension of the old stone road extending from East St. Louis along the main highway. The work was done by the local township commissioners under the general supervision of the State Highway Commission. The stone was furnished from the penitentiary at Menard and was shipped in and hauled and placed on the road previous to the arrival of the outfit for rolling it. The road was then rolled and bonded and very satisfactory results were obtained at a comparatively small cost. The work was paid for in part by the township commissioners and in part by subscriptions of labor or money. No cost data are available. The road was waterbound macadam 12 feet wide and 8 inches thick. The amount of road built was 5,300 feet; width of road 12 feet; amount of surface, 7,006 square yards.

SALEM.

SHELBY STREET ROAD, SALEM TOWNSHIP, MARION COUNTY.

The work at Salem was done under the direction of the mayor of Salem, the stone being hauled and placed on the road previous to the arrival of the outfit furnished by the State. The rolling and finishing of about two-thirds of the road was done under the supervision of an inspector furnished by the State Highway Commission, but on account of the failure to receive material to finish the road, it was impossible to allow the machinery to remain and after the State machinery had been taken away, the commissioners finished the work, using a horse-drawn roller. A total of 3,120 square yards of waterbound macadam, 12 feet wide and 8 inches thick, was finished. No cost data of this work are at hand.

NEW PHILADELPHIA.

MAIN STREET ROAD, MOUND TOWNSHIP, MCDONOUGH COUNTY.

Main street road extends along the main street of the village of New Philadelphia, and south to a main east and west road, and the total

South Morris avenue road, Bloomington Township, McLean County. Asphalt macadam, 12 feet wide, length, 3 miles. Built, 1911-1912.

length is about one-half mile. The soil is a black loam, and the road has only slight grades so that no considerable amount of earth work had to be done.

A bituminous macadam 8 inches thick and 12 feet wide was constructed with a bituminous binder. The crushed stone was placed in two courses, the lower course being 6 inches thick, and bonded with screenings. The upper course was made 3 inches thick, using 3-inch stone. After the upper course was thoroughly rolled, the surface interstices were filled with chips and broomed. Upon the surface prepared in this way, the bituminous binder was spread at the rate of 1¼ gallons per square yard of surface. The surface was then rolled, covered lightly with chips and broomed, after which a seal coat of about ¾ gallon of the binder per square yard was applied. The surface was again rolled and covered lightly with chips, and opened for traffic. Binder No. 13 was used.

Stone for the improvement was furnished from the penitentiary at Joliet, and the cost of the improvement was paid from a fund raised by subscription.

The following table is an itemized statement of the cost of this work:

Length of road	2,775 feet
Width of macadam: 100 ft.-40 ft.; 1,915 ft.-12 ft.; 760 ft.-16 ft.	
Macadam laid	4,348 sq. yds.
Stone in road	1,600 cu. yds.
Stone hauled from storage	1,600 cu. yds.
Average haul of stone	⅛ mile
Surface treated with bituminous binder	4,000 sq. yds.
Bituminous binder used	8,000 gallons
Average haul of tank wagon	⅛ mile
Rate of pay: Men, 17½ cents; teams, 35 cents per hour.	

COST OF LABOR AND SUPPLIES.

Superintendence	$ 78.00
Excavation	14.00
Shaping road bed	45.80
Loading stone	66.60
Hauling stone, including rehandling	323.95
Spreading stone	129.60
Trimming shoulders and side roads	4.80
Rolling and sprinkling	47.00
Watchman and miscellaneous labor	56.55
Coal, oil and supplies	33.20
Heating bituminous binder	72.00
Hauling and spreading bituminous binder	65.90
Cost of bituminous binder	520.00
Freight on stone	1,696.00
Total	$3,153.40

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone on wagons	$0.0416
Hauling stone, including rehandling	.2024
Spreading stone	.0811
Rolling and sprinkling	.0294
Watchman and miscellaneous labor	.0354
Coal, oil and supplies	.0208
Total	$0.4107

COST PER GALLON FOR APPLYING BINDER.

Heating	$0.009
Hauling and spreading	.008
Total	$0.017

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.0179
Excavation	.0032
Shaping road bed	.0105
Trimming shoulders and side roads	.0011
Placing stone	.1540
Applying bituminous binder	.0317
Cost of bituminous binder	.1196
Freight on stone	.3905
Total	$0.7285

ARROWSMITH.

NORTH AND SOUTH MAIN ROAD, ARROWSMITH TOWNSHIP, MCLEAN COUNTY.

The Arrowsmith experimental road extends north and south from the L. E. & W. railroad in the village of Arrowsmith to the main cross roads, which are a half mile each side of the town. This is the only road leading into Arrowsmith. The country is somewhat rolling, but the road was fairly well graded and drained before the macadam construction was begun. The soil is a black, sticky loam. Stone for the improvement was furnished from the penitentiary at Joliet, and funds for carrying on the work were raised by a special levy for road purposes. The stone was placed in two layers of a combined thickness of 8 inches after rolling, and the macadam was made 12 feet wide, except on the main business block of the village, where it was made the full width of the street, about 50 feet.

The road was finished as a waterbound macadam with Joliet screenings, and then dressed with good bonding gravel.

The following table is an itemized statement of the cost of this work:

Length of road	5,300 feet
Width of macadam: 5,120 ft.-12 ft.; 180 ft.-53 ft.	
Macadam laid	7,887 sq. yds.
Stone in road	2,185 cu. yds.
Stone hauled from cars	1,705 cu. yds.
Stone hauled from storage pile	480 cu. yds.
Average haul of stone	¼ mile
Rate of pay: Men, 20 cents; teams, 30-40 cents per hour.	

COST OF LABOR AND SUPPLIES.

Superintendence	$ 247.50
Excavation	394.80
Shaping road bed	202.15
Loading stone	369.15
Hauling stone, including rehandling	471.15

Spreading stone	$ 247.10
Trimming shoulders and side roads	214.40
Rolling and sprinkling	147.50
Watchman and miscellaneous labor	61.45
Coal, oil and supplies	76.00
Gravel binder delivered	193.10
Freight on stone and car service	2,618.28
Total	$5,242.58

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone	$0.16890
Hauling stone, including rehandling	.21562
Spreading stone	.11309
Rolling and sprinkling	.06750
Watchman and miscellaneous labor	.02812
Coal, oil and supplies	.03480
Total	$0.62803

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.03138
Excavation	.05005
Shaping road bed	.02563
Trimming shoulders and side roads	.02718
Placing stone	.17400
Gravel binder	.02448
Freight on stone	.33190
Total	$0.66462

PEKIN.

WEST BLUFF ROAD, HOLLIS TOWNSHIP, PEORIA COUNTY.

The West Bluff experimental road begins at the north end of the Illinois River bridge in Pekin and extends across the Illinois River bottoms to the village of Orchard Mine, a distance of about two miles. The road is constructed on an embankment which was thrown up, when a drainage ditch was dug alongside the road. The material which formed the embankment is a blue clay which retains water very tenaciously and which is very unstable with a small amount of water. A part of the embankment had been thrown up a number of years previous to the construction, and had been traveled until thoroughly compacted, but the embankment had recently been widened by the addition of the material mentioned so that one-half of the road was on a firm foundation while the other half of the road was on a poor foundation. On account of these conditions there were sections of the road which could not be properly rolled because of soft foundation.

Four sizes of stone, 3-inch, 2-inch and ¾-inch chips free from dust, and screenings which would pass a ¼-inch screen were used in the construction.

The macadam was placed in two courses, having a total thickness when finished of 9 inches at the crown and 6 inches at the edges. The upper course was 3 inches thick. The lower course was made of the 2-inch

Burke's lane, Carlinville Township, Macoupin County. Concrete road, 16 feet wide. Built, 1912.

stone, thoroughly harrowed, rolled and bound with screenings; the top course was spread, harrowed, rolled and partially covered with chips to fill the surface interstices. Upon this surface was spread 1½ gallons per square yard of tar binder, applied by spraying through a specially constructed nozzle. After the first treatment of tar binder had been applied to the surface, it was covered lightly with chips which were broomed into the surface voids and rolled. After this had been done, a second spreading of ½ gallon per square yard of the binder was made in the same manner. The binder was received in tank cars and heated in the cars to a temperature of from 200 to 225 degrees F., and was applied to the surface at a temperature of approximately 200 degrees.

The tar binders used were as follows: Station 60 to 88, No. 121; Station 32 to 60, No. 123; Station 0 to 32, No. 125; for painting spots throughout, No. 127.

The following table is an itemized statement of the cost of this work:

Length of road	8,400 feet
Width of macadam	16 feet
Macadam laid	14,933 sq. yds.
Stone in road	5,779 cu. yds.
Stone hauled from cars	5,179 cu. yds.
Stone hauled from storage	600 cu. yds.
Average haul of stone	1 mile
Surface treated with bituminous binder	14,933 sq. yds.
Bituminous binder used	30,000 gallons
Average haul of tank wagon	1 mile

Rate of pay: Men, 22 2-9 cents; teams, 50 cents per hour; spreading binder, men, 22 2-9 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 206.30
Excavation	333.10
Shaping road bed	515.04
Loading stone on wagons	707.28
Hauling stone, including rehandling	2,400.54
Spreading stone	771.37
Trimming shoulders and side roads	266.40
Rolling and sprinkling	257.85
Watchman and miscellaneous labor	421.11
Coal, oil and supplies	41.53
Heating bituminous binder	100.00
Hauling and spreading bituminous binder	108.90
Cost of bituminous binder	1,950.00
Freight on stone	4,478.26
Total	$12,557.68

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone on wagons	$0.1222
Hauling stone, including reloading	.4160
Spreading stone	.1334
Rolling and sprinkling	.0446
Watchman and miscellaneous labor	.0728
Coal, oil and supplies	.0072
Total	$0.7962

COST PER GALLON FOR APPLYING BINDER.

Heating	$0.00333
Hauling and spreading	.00363
Total	$0.00696

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.0138
Excavation	.0223
Shaping road bed	.0345
Trimming shoulders and side roads	.0178
Placing stone	.3078
Applying bituminous binder	.0140
Cost of bituminous binder	.1306
Freight on stone	.2990
Total	$0.8398

PEORIA.

PROSPECT HEIGHTS ROAD, RICHWOOD TOWNSHIP, PEORIA COUNTY.

The section improved on this road begins at the end of the pavement on Prospect avenue in Peoria and extends in a northerly direction in Richwood Township for a distance of about two miles. Many unfavorable conditions were encountered on this construction. The country is rolling and the road is hilly and poorly drained, but on account of an agreement between the township commissioners and the street car company that operates a line along one side of the road, it was impossible to change the grade of the road which rendered proper drainage of the foundation very difficult in some places. In other places where underdrainage was imperative, the commissioners would not put it in. The soil is a yellow clay. Stone for the improvement was furnished from the penitentiary at Joliet, a part being shipped in and unloaded the winter before the construction began. The work was laid out as waterbound macadam, but after a large part of the construction had been completed, it was decided to surface the macadam with an asphaltic binder.

Four sizes of stone were used on the work as follows: 3-inch stone, 2-inch stone, ¾-inch limestone chips and screenings passing a ¼-inch screen.

The lower course was made of 2-inch stone and the upper course of 3-inch, each spread to compact to a thickness of 4 inches. After the upper course of stone had been rolled, the surface voids were partly filled with the ¾-inch chips and the asphalt applied by means of hand sprinkling cans. The binder was received in tank cars but was of such a nature that it could not be heated sufficiently by means of the steam coils in the tank cars, and as a result it had to be applied to the road at too low a temperature. As a result of low temperature and the method of application, the asphalt failed to penetrate the macadam sufficiently and left the surface uneven.

The bituminous binders used were as follows: Rock Island R. R. to north end, No. 129; Station 40 to Rock Island R. R., No. 130; Station 0 to 45, No. 131.

The following table is an itemized statement of the cost of this work:

Length of road	9,700	feet
Width of macadam	12	feet
Macadam laid	12,950	sq. yds.
Stone in road	4,581	cu. yds.
Stone hauled from cars	3,461	cu. yds.
Stone hauled from storage	1,120	cu. yds.
Average haul of stone	1	mile
Surface treated with bituminous binder	12,950	sq. yds.
Bituminous binder used	25,000	gallons
Average haul of tank wagon	1	mile

Rate of pay: Men, 25 cents; teams, 50 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 668.61
Excavation	1,404.88
Shaping road bed	529.06
Loading stone	125.00
Hauling stone, including rehandling	2,685.27
Spreading stone	743.31
Trimming shoulders and side roads	350.98
Rolling and sprinkling	493.52
Coal, oil and supplies	200.32
Heating bituminous binder	182.70
Hauling and spreading bituminous binder	106.88
Cost of asphalt binder	780.90
Contractor's profit	800.00
Freight on stone	3,982.17
Total	$13,053.60

COST PER CUBIC YARD FOR PLACING STONE.

Contractor's profit	$0.1746
Loading stone on wagons	.0273
Hauling stone, including rehandling	.5865
Spreading stone	.1622
Rolling and sprinkling	.1075
Coal, oil and supplies	.0400
Total	$1.0981

COST PER GALLON FOR APPLYING BINDER.

Heating	$0.0073
Hauling and spreading	.0043
Total	$0.0116

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.0516
Excavation	.1085
Shaping road bed	.0407
Trimming shoulders and side roads	.0271
Placing stone	.3280
Applying bituminous binder, including cost of binder	.0829

A. St. Louis road, Collinsville Township, Madison County. Before improvement. Loose soil.

B. St. Louis road, Collinsville Township, Madison County. Waterbound macadam, concrete gutters. Note concrete wing walls across ditches to prevent wash. See plates 1 and 3.

Freight on stone	$ .3075
Contractor's profit	.0617
Total	$1.0080

State Fair Grounds.

The State Fair grounds experimental road was constructed on one of the main streets in the fair grounds, beginning at the intersection north of the Woman's bldg., and extending west to the swine barn.

The road was constructed for the purpose of comparing in service various bituminous binders. The roadway is divided into nine sections upon which eight kinds of binder were used. The various sections were marked by a sign bearing the name and manufacturer of the material used, and the limits of each section are marked on the curbing. The sections and materials used on them were as follows:

SECTION.	LAB. NO.	MATERIAL.	MANUFACTURER.
1	204	Sarco	Standard Asphaltum & Rubber Co.
2	...	Glutrin	Robson Process Co.
3	208	Taroid	F. J. Lewis Co.
4	201	Indian Asphalt binder	Indian Refining Co.
5	202	Standard Asphalt macadam binder	Standard Oil Co.
6	203	Pioneer	American Asphaltum & Rubber Co.
7	...	Calcium Chloride	Semet-Solvay Co.
8	209	Tarvia X	Barrett Manufacturing Co.
9	203	Pioneer	American Asphalt & Rubber Co.

The bituminous macadam pavement was placed between a concrete combined curb and gutter, and was designed with a crown of ¾-inch per foot. The widths of the pavement are 35 feet and 45 feet, being adjusted to conform to the existing roadway.

The crushed stone was placed in two layers, the lower course being 6 inches thick at the crown line and 4 inches thick at the curb line, and was thoroughly rolled and bonded with screenings. The upper course was made of stone ranging in size from 2 inches to ¾ inch, and was placed in a layer 3 inches thick after being rolled.

The upper course was thoroughly rolled and the binders applied with hand spreading cans. After the binder was spread the surface of the macadam was covered with coarse chips and thoroughly rolled. On section 6 after the chips had been rolled, the excess was brushed off and a seal coat of asphalt applied. The seal coat was covered lightly with chips and thoroughly rolled.

The binders used were donated by the manufacturers, and were applied under the supervision of a representative of the firm furnishing the material.

The following table gives only the labor, cost and the freight on the stone:

Length of road		1,065 feet
Width of macadam	35 feet	45 feet
Macadam laid		4,700 sq. yds.
Stone in road		1,975 cu. yds.
Average haul of stone		¼ mile

Surface treated with bituminous binder..... 4,700 sq. yds.
Bituminous binder used..... 9,400 gallons
Average haul of tank wagon..... ¼ mile
Rate of pay: Men, 17½ cents; teams, 40 cents per hour; spreading binder, men, 25 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$165.00
Excavation	96.28
Shaping road bed	58.49
Loading stone	263.92
Hauling stone, including reloading	398.69
Spreading stone	140.26
Trimming shoulders and side roads	1.14
Rolling and sprinkling	112.50
Watchman and miscellaneous labor	118.52
Coal, oil and supplies	29.99
Heating bituminous binder	41.23
Hauling bituminous binder	12.55
Freight on stone	938.68
Total	$2,377.25

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone on wagons	$0.1335
Hauling stone, including reloading	.2022
Spreading stone	.0710
Rolling and sprinkling	.0570
Watchman and miscellaneous labor	.0602
Coal, oil and supplies	.0151
Total	$0.5390

COST PER GALLON FOR APPLYING BINDER.

Heating and spreading	$0.01162
Hauling	.00354
Total	$0.01516

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.03510
Excavation	.02048
Shaping road bed	.01245
Trimming shoulders and side roads	.00020
Placing stone	.22630
Applying bituminous binder	.01144
Freight on stone	.19970
Total	$0.50567

O'FALLON.

O'FALLON-SHILOH VALLEY ROAD, O'FALLON TOWNSHIP, ST. CLAIR COUNTY.

This work was begun at the B. & O. railroad tracks on what is known as Depot street in the city of O'Fallon and extends in a southerly direc-

tion along Depot street to the city limits, and thence in a southerly direction in the township along what is known as the O'Fallon-Shiloh Valley road.

The portion of the work constructed within the city of O'Fallon was made 16 feet wide and was surfaced with asphaltic binder. The portion of the work in the township was 12 feet wide and finished as waterbound macadam. The village street required very little grading, but the work in the township was through rolling country and required a considerable amount of grading. The soil is black loam on part of the road and part of it yellow clay.

Stone for the improvement was furnished from the penitentiary at Menard and the part of the work in the city was paid from the city funds, while the portion of the work in the township was paid for by a special hard road tax.

Bituminous macadam construction.

The stone was placed in two courses having a total thickness of 9 inches at the crown and 6 inches at the edge. The upper course was of a uniform thickness of 3 inches. The lower course of 2-inch stone was spread and thoroughly harrowed, rolled and bonded with screenings and water. The upper course was of 3-inch stone and was spread, harrowed and thoroughly rolled. The surface interstices were then filled with ¾-inch chips swept into the surface. On the surface prepared in this way, 1½ gallons per square yard of surface of the asphaltic binder were applied by means of hand spreading cans. The asphalt was received in drums and heated in a portable kettle alongside the road and was applied at a temperature of 350 degrees to 400 degrees F. After the first spreading of the asphaltic compound the surface was rolled, covered again with ¾-inch chips, which were brushed into all the remaining voids in the surface, and then covered with about ½ gallon per square yard of the asphaltic compound as a seal coat. It was then rolled, dusted lightly with chips and opened to traffic.

Two asphaltic binders were used: No. 136, which was used from the B. & O. railroad tracks to station 13; and No. 135, which was used from station 13 to the city limits.

The stone for the waterbound macadam was spread in two approximately equal layers having a total thickness of 8 inches when rolled, each layer being spread, harrowed and rolled, and the surface layer being bonded with screenings and water.

The following table is an itemized statement of the cost of this work:

Length of road	2,588 feet
Width of macadam	16 feet
Macadam laid	4,601 sq. yds.
Stone in road	1,560 cu. yds.
Stone hauled from cars	1,300 cu. yds
Stone hauled from storage	260 cu. yds.
Average haul of stone	¼ mile
Surface treated with bituminous binder	4,601 sq. yds.
Bituminous binder used	9,200 gallons

Rate of pay: Men, 25 cents; teams, 50 cents per hour; spreading binder, men, 25 cents per hour.

A. Tri-City road, Venice Township, Madison County, showing road after being resurfaced. Bituminous macadam, 16 feet wide.

B. Macadam construction. Tile under drain to remedy seepy places in center of road. Such places usually occur on hill sides.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 63.00
Excavation	39.50
Shaping road bed	31.25
Loading stone	76.38
Hauling stone, including rehandling	382.37
Spreading stone	105.38
Trimming shoulders and side roads	47.88
Rolling and sprinkling	44.00
Watchman and miscellaneous labor	97.25
Coal, oil and supplies	18.61
Heating bituminous binder	6.25
Hauling and spreading bituminous binder	91.25
Cost of bituminous binder	642.50
Freight on stone	1,131.73
Total	$2,777.35

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone on wagons	$0.0409
Hauling stone, including rehandling	.2445
Spreading stone	.0675
Rolling and sprinkling	.0282
Watchman and miscellaneous labor	.0593
Coal, oil and supplies	.0120
Total	$0.4524

COST PER GALLON FOR APPLYING BINDER.

Heating	$0.00068
Hauling and spreading	.00990
Total	$0.01058

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.0137
Excavation	.0085
Shaping road bed	.0067
Trimming shoulders and side roads	.0104
Placing stone	.1575
Applying bituminous binder	.0212
Cost of bituminous binder	.1395
Freight on stone	.2459
Total	$0.6034

Length of macadam	7,312 feet
Width of macadam	12 feet
Macadam laid	9,570 sq. yds.
Amount of stone in road	3,266 cu. yds.
Amount of stone hauled from cars	3,266 cu. yds.
Average haul of stone	1¼ miles

Rate of pay: Men, 25 cents; teams, 50 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 264.38
Excavation	606.25
Shaping road bed	167.50
Loading stone on wagons	235.85
Hauling stone, including rehandling	1,713.58
Spreading stone	338.15
Trimming shoulders and side roads	88.00
Rolling and sprinkling	259.60
Watchman and miscellaneous labor	214.50
Coal, oil and supplies	76.79
Freight on stone	2,644.37
Total	$6,608.97

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone	$0.07221
Hauling stone, including rehandling	.52467
Spreading stone	.10353
Rolling and sprinkling	.07947
Watchman and miscellaneous labor	.06567
Coal, oil and supplies	.02351
Total	$0.86906

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.02761
Excavation	.06335
Shaping road bed	.01750
Trimming shoulders and side roads	.00919
Placing stone	.29660
Freight on stone	.27631
Total	$0.69056

MORRISON.

MORRISON AND DENROCK ROAD, MT. PLEASANT TOWNSHIP, WHITESIDE COUNTY.

The work begins at the south corporation line of the city of Morrison and extends about one mile in a southerly direction. The country is somewhat rolling. The soil on a part of the road was a black gumbo, while on another part of the road it was very sandy. Near the south end of the construction there was a section of old macadam which was shaped up and resurfaced. Stone for the improvement was furnished from the penitentiary at Joliet and the road was finished in the manner of an ordinary waterbound macadam except that sandy loam taken from alongside the road was mixed with the Joliet screenings upon the surface. The cost of the construction was paid from a special hard road fund raised by special tax.

The following table is an itemized statement of the cost of the work:

Length of road	5,400 feet
Width of macadam	12 feet
Macadam laid	7,200 sq. yds.
Stone in road	1,900 cu. yds.
Stone hauled from cars	1,440 cu. yds.
Stone hauled from storage pile	460 cu. yds.
Average haul of stone	¾ mile

Rate of pay: Men, 20 cents; teams, 40 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 168.50
Excavation	472.00
Shaping road bed	38.60
Loading stone	253.20
Hauling stone, including rehandling	724.85
Spreading stone	162.70
Trimming shoulders and side roads	42.00
Rolling and sprinkling	133.30
Watchman and miscellaneous labor	36.00
Coal, oil and supplies	43.60
Freight on stone, including car service	1,925.35
Total	$4,000.10

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone	$0.13320
Hauling stone, including rehandling	.38150
Spreading stone	.08563
Rolling and sprinkling	.07025
Watchman and miscellaneous labor	.01894
Coal, oil and supplies	.02290
Total	$0.71242

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.0234
Excavation	.0656
Shaping road bed	.0054
Trimming shoulders and side roads	.0058
Placing stone	.1880
Freight on stone	.2680
Total	$0.5562

MAINTENANCE WORK, 1910.

REPAIRS TO NORTH ROAD, DOUGLAS TOWNSHIP, EFFINGHAM COUNTY.

In 1907 an experimental road was constructed on the north road out of Effingham, beginning at the north end of the pavement on Fourth street. At the time the road was built, the quarry at the Southern Peni-

West Bluff road, Hollis Township, Peoria County. Tar macadam, 16 feet wide. Built, 1910. Surface painted with tar and torpedo sand in 1912. Photographed after resurfacing.

tentiary was just opened and a considerable amount of inferior stone was of necessity put through the crusher, and some of it was used on the Effingham north road. Partly as a result of the use of poor stone and partly on account of the nature of the traffic, some sections of the road wore rapidly and rutted considerably. While the State outfit was in the township building the Fayette avenue road, the commissioners decided to repair the north road. The rutted and worn sections were spiked up, harrowed and resurfaced with a small amount of additional stone at a cost of $152.00 for a total of 7,000 square yards.

RESURFACING ON FIELDON ROAD, JERSEY TOWNSHIP, JERSEY COUNTY.

Work on the Fieldon road was not quite finished when the season closed in the fall of 1909 and in the spring of 1910 a little additional work was done in surfacing the unfinished portion of the work. In addition a section of old macadam adjoining the State experimental road was resurfaced. The existing macadam was spiked up and harrowed and additional stone added to make the required shape to the surface. The stone was then rolled and bonded with screenings and water.

The cost of this work is given in the following tables:

Length of macadam	6,600 feet
Width of macadam	12 feet
Macadam resurfaced	8,800 sq. yds.
Amount of stone in road	238 cu. yds.
Amount of stone hauled from cars	81 cu. yds.
Amount of stone hauled from storage pile	157 cu. yds.
Average haul of stone	2 miles

Rate of pay: Men, 20 cents; teams, 36 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 90.00
Excavation	37.08
Hauling stone, including rehandling	278.12
Spreading stone	127.98
Trimming shoulders and side roads	22.12
Rolling and sprinkling	102.86
Watchman and miscellaneous labor	80.36
Coal, oil and supplies	71.22
Freight on stone	523.36
Total	$1,333.10

COST PER SQUARE YARD RESURFACED MACADAM.

Superintendence	$0.0100
Excavation	.0040
Trimming shoulders and side roads	.0025
Placing stone	.0750
Freight on stone	.0595
Total	$0.1510

EXPERIMENTAL ROADS CONSTRUCTED IN 1911.

BEARDSTOWN.

BEARDSTOWN-CHANDLERVILLE ROAD, ROAD DISTRICT NO. 3, CASS COUNTY.

The Beardstown-Chandlerville experimental road was constructed on very sandy soil in the Illinois River bottoms. The road began just within the city limits of Beardstown on the Chandlerville road, and extended in a northeasterly direction for a distance of 6,250 feet. A short section of this road was made 16 feet wide, the remainder of the road being 10 feet wide.

The country is somewhat rolling, and a part of the road is on an embankment through low land which is a part of the Illinois River bottom. The road had in the past been raised across these bottoms, but not sufficiently high to be above flood water. It was thought advisable by the commissioners to raise this road about two feet.

In order to secure material for the embankment, considerable amount of cutting was done on other parts of the road which might not otherwise have been desirable. Even after using all the available material, the embankment upon which the road is built is too narrow for satisfactory service, and its ultimate widening will be a necessity.

The improvement was financed by the road district and the county jointly, the money being handled through a committee known as the Road Improvement Association of Beardstown. The entire road was surfaced with a bituminous binder, the macadam being 6 inches thick after rolling, which is thick enough for the type of soil encountered.

The upper layer of stone was of 2½-inch stone 3 inches thick before rolling. The upper course was rolled and partially filled with ¾-inch limestone chips before any binder was spread. After the first application of binder, chips were again spread and brushed into the voids in the surface. A second application of binder was then made and covered with coarse sand. The binder was applied with the special apparatus of the Illinois Highway Commission.

Binder No. 146 was used in the construction. The following table is an itemized statement of the cost of this work:

Length of macadam	6,250 feet
Width of macadam: 5,500 ft.-10 ft. wide; 600 ft.-16 ft. wide; 150 ft.-12 ft. wide.	
Macadam laid	7,482 sq. yds.
Stone in road	2,063 cu. yds.
Stone hauled from storage pile	2,266 cu. yds.
Average haul of stone	1 mile
Amount of surface treated with bituminous binder	7,482 sq. yds.
Amount of bituminous binder used	15,500 gallons
Rate of pay: Men, 17½-20 cents; teams, 35-40 cents per hour.	

COST OF LABOR AND SUPPLIES.

Superintendence	$ 255.40
Excavation	869.68
Shaping road bed	116.75

Hauling stone, including rehandling	$1,331.91
Spreading stone	189.97
Trimming shoulders and side roads	20.55
Rolling and sprinkling	228.00
Watchman and miscellaneous labor	57.62
Coal, oil and supplies	46.19
Applying bituminous binder	170.80
Cost of bituminous binder	701.98
Freight on stone	2,335.49
Total	$6,324.34

COST PER CUBIC YARD FOR PLACING STONE.

Unloading stone from cars	$0.142
Hauling stone, including rehandling	.503
Spreading stone	.092
Rolling and sprinkling	.111
Watchman and miscellaneous labor	.028
Coal, oil and supplies	.022
Total	$0.898

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.034
Excavation	.116
Shaping road bed	.015
Trimming shoulders and side roads	.003
Placing stone	.248
Applying bituminous binder, including cost of binder	.117
Freight on stone	.312
Total	$0.845

CASEY.

EAST WASHINGTON STREET ROAD, CASEY TOWNSHIP, CLARK COUNTY.

The East Washington street experimental road begins at the end of the pavement on east Washington street in the city of Casey, and extends in an easterly direction 6,000 feet. The soil is a light clay, and the road was very hilly. The fact that the width of the road between fences was only 35 to 40 feet, made it impossible to do much toward reducing the grades on the road. Some earth work was done, however, and grades reduced as much as possible.

Stone for the improvement was purchased from Greencastle, Indiana, and the improvement was paid from the proceeds of a hard road tax levied for the purpose. The road is waterbound macadam 8 inches thick and 12 feet wide.

The following table is an itemized statement of the cost of this work:

Length of macadam	5,810 feet
Width of macadam: 4,010 ft.-12 ft. wide; 1,800 ft.-14 ft. wide.	
Macadam laid	8,147 sq. yds.
Stone in road	2,597 cu. yds.
Stone hauled from cars	2,597 cu. yds.
Average haul of stone	1¼ miles

Rate of pay: Men, 15 cents; teams, 35 cents per hour.

Cemetery road, Pekin Township, Tazewell County. Asphalt macadam, 16 feet wide. Built, 1912.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 147.00
Excavation	376.05
Shaping road bed	153.15
Loading stone on wagons	267.60
Hauling stone, including rehandling	701.40
Spreading stone	157.15
Trimming shoulders and side roads	168.45
Rolling and sprinkling	230.50
Coal, oil and supplies	54.75
Cost of stone	2,983.00
Total	$5,239.05

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone on wagons	$0.103
Hauling stone, including rehandling	.270
Spreading stone	.061
Rolling and sprinkling	.089
Coal, oil and supplies	.021
Total	$0.544

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.018
Excavation	.046
Shaping road bed	.019
Trimming shoulders and side roads	.021
Placing stone	.173
Cost of stone	.366
Total	$0.643

OBLONG.

RANGE STREET ROAD, OBLONG TOWNSHIP, CRAWFORD COUNTY.

The Range street road extends entirely through the village of Oblong along the main street north and south, and was improved for a length of one mile. The soil is a light clay, which is very unstable when slightly wet and the road near the ends was poorly drained. The macadam was placed between combined concrete curb and gutter, a part of the macadam being 20 feet wide, and a part 26 feet wide.

The improvement was paid from the proceeds of a special assessment for the purpose.

This road in Oblong is a connecting link in a system of macadam roads, which extends entirely across the township north and south. The road was built in accordance with the specifications of the State Highway Commission for bituminous macadam construction, and was surfaced with binders No. 139, 144, 147, 148 and 149. The bituminous binders were distributed with hand spreading cans.

Stone for the improvement was furnished from the penitentiary at Menard, and a considerable amount was shipped in and unloaded before the construction work on the road began. On about 1,600 feet of this road the lower course was placed in the fall of 1910, being bonded with gravel and left open to traffic over winter.

The following table is an itemized statement of the cost of this work:

Length of macadam	5,280 feet
Width of macadam: 1,380 ft.-26 ft. wide; 3,900 ft.-20 ft. wide.	
Macadam laid	12,653 sq. yds.
Stone in road	3,997 cu. yds.
Stone hauled from cars	1,817 cu. yds.
Stone hauled from storage pile	2,180 cu. yds.
Average haul of stone	3-16 mile
Amount of surface treated with bituminous binder	12,653 sq. yds.
Amount of bituminous binder used	1,083 tons
Rate of pay: Men, 17½ cents; teams, 40 cents per hour.	

COST OF LABOR AND SUPPLIES.

Superintendence	$ 330.00
Excavation and shaping road bed	1,359.30
Loading stone on wagons	523.20
Hauling stone, including rehandling	1,966.69
Spreading stone	357.87
Rolling and sprinkling	238.18
Watchman and miscellaneous labor	396.25
Coal, oil and supplies	72.61
Applying bituminous binder	218.37
Cost of bituminous binder	2,314.52
Freight on stone, including gravel binder	3,842.65
Total	$11,619.64

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone on wagons	$0.131
Hauling stone, including rehandling	.492
Spreading stone	.089
Rolling and sprinkling	.060
Watchman and miscellaneous labor	.099
Coal, oil and supplies	.018
Total	$0.889
Cost per gallon for applying bituminous binder	$0.0081

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.026
Excavation and shaping road bed	.107
Placing stone	.281
Applying bituminous binder, including cost of binder	.200
Freight on stone	.304
Total	$0.918

ROBINSON.

INDIAN BOUNDARY ROAD, ROBINSON TOWNSHIP, CRAWFORD COUNTY.

The Robinson experimental work began about two and one-half miles northwest of the city of Robinson at the end of an old macadam road which had been constructed by the township commissioners some years previous. The new work extended in a northwesterly direction for a distance of 5,800 feet. The soil is a light clay, which is very unstable when slightly wet. The old road was poorly drained on flat land, requiring considerable work in order to secure a proper outlet for surface water. In the course of the construction, one concrete bridge of about 10 foot span was built, the work being done by day labor in accordance with plans furnished by the State Engineer. The macadam was made 10 feet wide and 8 inches thick. Funds for the work were secured from those remaining after a voted road had been constructed with the proceeds of a hard road tax levied in the township.

Stone for the improvement was furnished from the penitentiary at Menard, and a part of the material was shipped in and unloaded before construction work began.

The following table is an itemized statement of the cost of this work:

Length of macadam	5,655 feet
Width of macadam	10 feet
Macadam laid	6,280 sq. yds.
Stone in road	1,880 cu. yds.
Stone hauled from cars	80 cu. yds.
Stone hauled from storage pile	1,800 cu. yds.
Average haul of stone	3 miles

Rate of pay: Men, 20 cents; teams, 50 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 171.50
Shaping road bed	286.75
Loading and hauling stone, including rehandling	1,740.34
Spreading stone	243.25
Trimming shoulders and side roads	268.15
Rolling and sprinkling	178.75
Watchman and miscellaneous labor	38.50
Coal, oil and supplies	45.72
Contractor's profit	384.40
Freight on stone	2,100.92
Total	$5,458.28

COST PER CUBIC YARD FOR PLACING STONE.

Contractor's profit	$0.204
Loading and hauling stone, including rehandling	.926
Spreading stone	.129
Rolling and sprinkling	.095
Watchman and miscellaneous labor	.021
Coal, oil and supplies	.024
Total	$1.399

A. End post of Coles Creek bridge.

This view illustrates a condition which frequently results from the almost universal lack of proper attention to the maintenance of steel highway bridges. An occasional, thorough cleaning, followed by a coat of good paint is absolutely necessary for the preservation of steel bridges.

B. Old Coles Creek Bridge, East Peoria, Fondulac Township, Tazewell County.

A steel bridge which had become so badly rusted as to render it unsafe for ordinary team traffic. The view above shows the rusted condition of one of the end posts and plate 22 the concrete slab structure built at this site.

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.027
Shaping road bed	.046
Trimming shoulders and side roads	.043
Placing stone	.358
Freight on stone	.334
Contractor's profit	.061
Total	$0.869

DeKalb.

FOURTH STREET ROAD, DE KALB TOWNSHIP, DE KALB COUNTY.

Fourth street road is an extension of a macadam road previously constructed at the south end of Fourth street. The macadam was constructed 10 feet wide, and one mile of road was built. The soil is a black, slightly sandy loam, and the country is only slightly rolling, and no considerable amount of grading had to be done.

Stone for the improvement was furnished from the penitentiary at Joliet, and most of it was shipped in and unloaded previous to the beginning of the macadam construction.

The road is waterbound macadam, upon which the commissioners were advised to place a gravel dressing. This was not done, however, prior to the removal of the State outfit from the work. On this work the State Highway Commission furnished general superintendence and the machinery for placing the stone, but the work was done under the direct supervision of the township highway commissioners.

The following table is an itemized statement of the cost of this work:

Length of macadam	5,280 feet
Width of macadam	10 feet
Macadam laid	5,867 sq. yds.
Amount of stone in road	1,800 cu. yds.
Amount of stone hauled from cars	300 cu. yds.
Amount of stone hauled from storage pile	1,500 cu. yds.
Average haul of stone	2¼ miles

Rate of pay: Men, 25 cents; teams, 45 cents per hour.

COST OF LABOR AND SUPPLIES.

Excavation, trimming shoulders and side roads, shaping road bed	$ 551.75
Unloading stone in storage	790.85
Hauling and spreading stone, including rehandling	906.10
Rolling and sprinkling	90.00
Coal, oil and supplies	45.00
Freight on stone	1,125.00
Total	$3,508.70

COST PER CUBIC YARD FOR PLACING STONE.

Unloading stone from cars in storage, including haul to storage pile	$0.527
Hauling stone, including rehandling, spreading stone	.503
Rolling and sprinkling	.050
Coal, oil and supplies	.025
Total	$1.105

COST PER SQUARE YARD FINISHED MACADAM.

Excavation, shaping road bed, trimming shoulders and side roads	$0.094
Placing stone	.312
Freight on stone	.192
Total	$0.598

SHAWNEETOWN.

SOUTH MAIN STREET ROAD, SHAWNEE TOWNSHIP, GALLATIN COUNTY.

The macadam work began near the L. & N. R. R. and extended along the main highway into the country for a distance of about a mile in a northwesterly direction. A part was constructed in the fall of 1910, and the remainder early in 1911. The country, through which the road runs is usually overflowed each spring by the Ohio River, the soil being a light yellow clay. The road itself was constructed on an embankment which had been thrown up by the commissioners sometime previous to undertaking the macadam construction. The macadam was made 12 feet wide and 8 inches thick, bonded with screenings and dressed with Ohio River sand.

Stone for the improvement was furnished from the penitentiary at Menard and the work was paid for by funds derived from a special tax levied for the purpose.

The following table is an itemized statement of the cost of the work done on this road:

Length of macadam	6,120 feet
Width of macadam	12 feet
Macadam laid	8,160 sq. yds.
Amount of stone in road	2,650 cu. yds.
Amount of stone hauled from cars	90 cu. yds.
Amount of stone hauled from storage pile	2,560 cu. yds.
Average haul of stone	1¼ miles

Rate of pay: Men, 15 cents; teams, 25 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 178.00
Excavation	329.19
Shaping road bed	205.90
Loading and hauling stone, including rehandling	1,161.67
Spreading stone	200.70
Trimming shoulders and side roads	16.30
Rolling and sprinkling	114.97
Watchman and miscellaneous labor	80.98
Coal, oil and supplies	68.29
Applying sand to surface	27.75
Contractor's profit	75.00
Freight on stone	2,071.78
Total	$4,530.53

COST PER CUBIC YARD FOR PLACING STONE.

Contractor's profit	$0.028
Loading and hauling stone, including rehandling	.438
Spreading stone	.076
Rolling and sprinkling	.043
Watchman and miscellaneous labor	.031
Coal, oil and supplies	.026
Total	$0.642

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.022
Excavation	.040
Shaping road bed	.025
Trimming shoulders and side roads	.002
Placing stone	.203
Applying gravel binder, including cost of binder	.003
Freight on stone	.255
Contractor's profit	.005
Total	$0.555

DONOVAN.

EXTENSION OF EAST ROAD, BEAVER TOWNSHIP, IROQUOIS COUNTY.

During 1910 about one and one-half miles of macadam road were constructed along what is known as the East road out of Donovan, and in the spring of 1911 an additional one-half mile was built at the end of this first section of macadam.

The country is somewhat rolling, and a considerable amount of earth work was necessary in order to secure a satisfactory grade. The soil is a black, slightly sandy loam. The road was made 11 feet wide, and the macadam is 8 inches thick.

Stone for the improvement was furnished from the penitentiary at Joliet, and a part of it was shipped in and unloaded before work was begun. The road was bonded with Joliet screenings, although the commissioners were advised that better bonding screenings should be secured for finishing the surface.

The following table is an itemized statement of the cost of this improvement:

Length of macadam	2,600 feet
Width of macadam	11 feet
Macadam laid	3,177 sq. yds.
Amount of stone in road	1,013 cu. yds.
Amount of stone hauled from cars	1,013 cu. yds.
Average haul of stone	1½ miles

Rate of pay: Men, 20 cents; teams, 40 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$144.00
Excavation	256.40
Shaping road bed	88.20
Loading stone on wagons	152.80
Hauling stone, including rehandling	453.80
Spreading stone	104.40
Trimming shoulders and side roads	89.80
Rolling and sprinkling	98.60
Coal, oil and supplies	53.73
Freight on stone	727.28
Total	$2,169.01

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone on wagons	$0.150
Hauling stone, including rehandling	.445
Spreading stone	.103
Rolling and sprinkling	.097
Coal, oil and supplies	.053
Total	$0.848

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.045
Excavation	.081
Shaping road bed	.028
Trimming shoulders and side roads	.028
Placing stone	.272
Freight on stone	.229
Total	$0.683

Crescent City.

MAIN STREET ROAD, CRESCENT TOWNSHIP, IROQUOIS COUNTY.

The Crescent City experimental road is on the main east and west road through the village of Crescent City, and is one mile in length. The part of the road on two principle blocks in the village of Crescent City was surfaced with a bituminous binder, the remainder of the road being waterbound macadam 12 feet wide and 8 inches thick. The road on the two blocks in the city was made 40 feet wide, 9 inches thick at the crown and 6 inches thick at the edge, and was surfaced with binder No. 162.

The stone for the road was furnished from the Joliet penitentiary. The soil is a sticky, black loam, and the country is comparatively flat, but little grading being necessary.

Bonding screenings were shipped from Kenneth, Indiana, for surfacing the waterbound macadam. The portion of the road which was surfaced with bituminous binder was constructed with the lower course bonded with screenings. The upper course was made 3 inches thick before rolling and surfaced with bituminous binder. The bituminous
ler was distributed with hand spreading cans. Limestone chips
used in the bituminous construction.

The work was paid for in part by the village of Crescent City, and in part by the township commissioners from the township funds.

A misunderstanding arose during the construction of the road as to whether village or township should handle certain material. This delayed the completion of the work until wet weather made it impossible to finish properly the west 500 feet of road.

The following table is an itemized statement of the cost of this work:

Length of macadam	5,300 feet
Width of macadam: 4,500 ft.-12 feet wide; 800 ft.-40 ft. wide.	
Macadam laid: Waterbound, 6,242 sq. yds.; bituminous	3,455 sq. yds.
Amount of stone in road	3,319 cu. yds.
Amount of stone hauled from cars	3,319 cu. yds.
Average haul of stone	⅜ mile
Amount of surface treated with bituminous binder	3,455 sq. yds.
Amount of bituminous binder used	4,823 gallons
Rate of pay: Men, 20-25 cents; teams, 45 cents per hour.	

COST OF LABOR AND SUPPLIES.

Superintendence	$ 219.00
Excavation	363.55
Shaping road bed	195.15
Loading stone on wagons	280.45
Hauling stone, including rehandling	754.03
Spreading stone	282.00
Trimming shoulders and side roads	51.15
Rolling and sprinkling	435.00
Watchman and miscellaneous labor	75.10
Coal, oil and supplies	127.98
Applying bituminous binder	65.50
Cost of bituminous binder	281.18
Freight on stone and car service	2,491.34
Cost of bonding screenings	449.50
Total	$6,070.93

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone on wagons	$0.085
Hauling stone, including rehandling	.227
Spreading stone	.085
Rolling and sprinkling	.130
Watchman and miscellaneous labor	.022
Coal, oil and supplies	.039
Total	$0.588

COST PER SQUARE YARD FINISHED WATERBOUND MACADAM.

Superintendence	$0.022
Excavation	.036
Shaping road bed	.020
Trimming shoulders and side roads	.005
Placing stone	.206
Freight on stone and car service	.255
Cost of bonding screenings	.046
Total	$0.590

Coles Creek bridge, Fondulac Township, Tazewell County.

A reinforced concrete skew bridge of two spans, 19 feet each; 40-foot roadway, with a 6-foot sidewalk on each side. Built in 1911. Cost, $5,079.25, including 1,282 lineal feet of piling. Concrete Steel Construction Co. Peoria, Ill., contractors. Designed by the Illinois Highway Commission.

COST PER SQUARE YARD FINISHED BITUMINOUS MACADAM.

Superintendence	$0.022
Excavation	.036
Shaping road bed	.020
Trimming shoulders and side roads	.005
Placing stone	.206
Applying bituminous binder, including cost of binder	.100
Freight on stone	.255
Cost of bonding screenings	.046
Total	$0.690

DONOVAN.

BITUMINOUS SURFACING ON MAIN STREET, VILLAGE OF DONOVAN, IROQUOIS COUNTY.

In connection with the work on the East road in Donovan, a section of the road constructed in 1910 lying within the village of Donovan was surfaced with a bituminous binder. This surfacing was done on the section of the east road beginning at the Big Four railroad in Donovan, and extended east along the main street for a distance of about 1,500 feet. In all a total of 4,285 square yards of macadam was surfaced with bituminous binder.

The stone had been placed on this street the preceding season, and it was finished as a waterbound macadam and used during the winter. In applying the bituminous binder, the surface of the macadam was scarified, harrowed, rolled, the surface partially filled with chips and the asphalt spread in two applications and dressed with chips after each application of binder. The asphalt binder was distributed with hand spreading cans.

The expense of this work was paid by a special subscription raised in the village. Binder No. 143 was used.

The following table is an itemized statement of the cost of this work:

Length of macadam	1,730	feet
Width of macadam	50, 16 and 12	feet
Macadam resurfaced	4,285	sq. yds.
Amount of stone in road	133.5	cu. yds.
Amount of stone hauled from storage pile	133.5	cu. yds.
Average haul of stone	⅛	mile
Amount of surface treated with bituminous binder	4,285	sq. yds.
Amount of bituminous binder used	6,250	gallons

Rate of pay: Men, 20 cents; teams, 35 and 40 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 60.00
Loading stone on wagons	18.20
Hauling stone, including rehandling	61.75
Spreading stone	53.15
Rolling and sprinkling	2.00
Applying bituminous binder	108.60
Cost of bituminous binder	405.00
Freight on stone	80.10
Total	$788.80
Cost per gallon for applying bituminous binder	$0.0173

COST PER SQUARE YARD FOR SURFACING WITH ASPHALT.

Superintendence	$0.014
Placing stone	.031
Applying bituminous binder, including cost of binder	.120
Contractor's profit	.019
Total	$0.184

GRANT PARK.

WILSON ROAD, YELLOWHEAD TOWNSHIP, KANKAKEE COUNTY.

The Wilson road leads eastward from the south end of the macadam placed on the Chicago-Vincennes road in 1910 and extends in an easterly direction for a distance of one mile. The macadam was made 10 feet wide and 8 inches thick. The country is comparatively level, and no considerable amount of grading had to be done. The soil is a black sticky loam, and the road, before construction work began, was well drained.

Stone for the improvement was purchased at Thornton, and the work was paid for from the township funds. On this work the State Highway Commission furnished the plans, machinery and general supervision, the work being done under the direction of Chas. Hayden, one of the township highway commissioners.

The following statement of the cost of this work was furnished by Mr. Hayden:

Length of macadam	6,039	feet
Width of macadam	9	feet
Macadam laid	6,039	sq. yds.
Amount of stone in road	1,964	cu. yds.
Amount of stone hauled from cars	1,744	cu. yds.
Amount of stone hauled from storage pile	220	cu. yds.
Average haul of stone	1½	miles
Rate of pay:		
Men	$0.12½	per hr.
Teams:		
For stone haul	40	per hr.
For grading	45	per hr.

COST OF LABOR AND SUPPLIES.

Superintendence	$187.88
Shaping road bed	98.70
Loading and hauling stone, including rehandling	858.78
Spreading stone	266.25
Rolling and sprinkling	90.00
Coal, oil and supplies	48.61
Freight on stone	545.66
Total	$2,095.88

COST PER CUBIC YARD FOR PLACING STONE.

Hauling stone, including rehandling	$0.437
Spreading stone	.135
Rolling and sprinkling	.046
Coal, oil and supplies	.025
Total	$0.643

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.031
Shaping road bed	.016
Placing stone	.209
Freight on stone	.091
Total	$0.347

BRIDGEPORT.

NORTH MAIN STREET ROAD, BRIDGEPORT TOWNSHIP, LAWRENCE COUNTY.

The north Main street road in Bridgeport township begins at the north end of the Main street pavement, and extends in a northerly direction for a distance of 8,140 feet. The soil upon which the road is built is a light yellow clay, and the road had for a number of years been in a very bad condition and very poorly drained. When the construction began, the road was very uneven and full of mud holes, which were of long standing. On account of the nature of the soil considerable difficulty was encountered in compacting the foundation.

The road is through somewhat rolling country, and a considerable amount of grading had to be done. In addition to that which was necessary, on account of the unevenness of the road, a considerable additional amount was necessary in order to secure drainage. Two small concrete bridges and a small concrete culvert were constructed in connection with this improvement. About 500 feet of tile underdrainage was laid, beginning at about Station 60 and extending to Station 65.

Stone for the work was furnished from the penitentiary at Menard, and about 80 cars were shipped in and unloaded prior to the commencement of the construction.

The road was built 12 feet wide and 8 inches thick after being rolled. On account of unfavorable weather conditions, very little rolling could be done as the stone was placed, but the road was at once opened to the heavy oil field traffic, and when all the stone was placed, the entire surface was rolled and bonded. The work was paid from funds derived from a hard road tax voted by the township.

The following table is an itemized statement of the cost of this improvement:

Length of macadam	8,160	feet
Width of macadam	12	feet
Macadam laid	10,880	sq. yds.
Amount of stone in road	3,131	cu. yds.
Amount of stone hauled from storage pile	3,131	cu. yds.
Average haul of stone	2.7	miles

Rate of pay: Men, 25 cents; teams, 50 cents per hour.

A. End post of Coles Creek bridge.

This view illustrates a condition which frequently results from the almost universal lack of proper attention to the maintenance of steel highway bridges. An occasional, thorough cleaning, followed by a coat of good paint is absolutely necessary for the preservation of steel bridges.

B. Old Coles Creek Bridge, East Peoria, Fondulac Township, Tazewell County.

A steel bridge which had become so badly rusted as to render it unsafe for ordinary team traffic. The view above shows the rusted condition of one of the end posts and plate 22 the concrete slab structure built at this site.

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.027
Shaping road bed	.046
Trimming shoulders and side roads	.043
Placing stone	.358
Freight on stone	.334
Contractor's profit	.061
Total	$0.869

DeKalb.

FOURTH STREET ROAD, DE KALB TOWNSHIP, DE KALB COUNTY.

Fourth street road is an extension of a macadam road previously constructed at the south end of Fourth street. The macadam was constructed 10 feet wide, and one mile of road was built. The soil is a black, slightly sandy loam, and the country is only slightly rolling, and no considerable amount of grading had to be done.

Stone for the improvement was furnished from the penitentiary at Joliet, and most of it was shipped in and unloaded previous to the beginning of the macadam construction.

The road is waterbound macadam, upon which the commissioners were advised to place a gravel dressing. This was not done, however, prior to the removal of the State outfit from the work. On this work the State Highway Commission furnished general superintendence and the machinery for placing the stone, but the work was done under the direct supervision of the township highway commissioners.

The following table is an itemized statement of the cost of this work:

Length of macadam	5,280 feet
Width of macadam	10 feet
Macadam laid	5,867 sq. yds.
Amount of stone in road	1,800 cu. yds.
Amount of stone hauled from cars	300 cu. yds.
Amount of stone hauled from storage pile	1,500 cu. yds.
Average haul of stone	2¼ miles

Rate of pay: Men, 25 cents; teams, 45 cents per hour.

COST OF LABOR AND SUPPLIES.

Excavation, trimming shoulders and side roads, shaping road bed	$ 551.75
Unloading stone in storage	790.85
Hauling and spreading stone, including rehandling	906.10
Rolling and sprinkling	90.00
Coal, oil and supplies	45.00
Freight on stone	1,125.00
Total	$3,508.70

COST PER CUBIC YARD FOR PLACING STONE.

Unloading stone from cars in storage, including haul to storage pile	$0.527
Hauling stone, including rehandling, spreading stone	.503
Rolling and sprinkling	.050
Coal, oil and supplies	.025
Total	$1.105

A. Spring street bridge, city of Galena, JoDaviess County.

An old steel bridge, refloored in 1912, under the supervision of the State Highway Commission, with creosoted sub-plank on which is spread a bituminous wearing surface. The carpet of bitumen and gravel which forms the wearing surface and which may readily be renewed from time to time, prevents the sub-plank from wearing out. A floor of this character weighs but little more than ordinary plank floor and costs less to maintain. It is well adapted for use on old steel bridges which are not strong enough to carry, with safety, a concrete floor.

B. Spring street bridge, City of Galena, JoDaviess County.

This view shows the creosoted sub-plank in place on an old steel bridge, ready to receive the wearing surface of asphalt and gravel. Note the openings at the side to permit the rapid escape of surface water.

the funds available. The stone was placed 6 inches deep except that the thickness was increased to 8 inches on a few sections where there was no gravel. The entire road is waterbound macadam. After a considerable amount of the stone had been hauled and spread, the commissioners requested the State Commission to send them machinery and an engineer to help finish the work. The roller was sent rather late in the fall, and the work was not finished when the season closed. A total of 2½ miles was planned, of which 1½ was completed in 1911. The commission did not have an engineer on this work at the start and as much of the labor was donated, no accurate record of the cost was kept by the local commissioners.

EDWARDSVILLE.

EDWARDSVILLE-MARINE ROAD, EDWARDSVILLE TOWNSHIP, MADISON COUNTY.

The portion of the Edwardsville-Marine road upon which the macadam was placed is that section of the road adjoining the pavement on Vandalia street in the city of Edwardsville, and extending down what is known locally as the Marine Hill, under the Illinois Traction tracks, and across the creek bottom to a small bridge about one-half mile from the pavement.

The Marine Hill has always been a troublesome road on account of the steepness of the grades and the fact that the location of the Illinois Traction viaduct is such that vehicles going down the hill had no view of the road beyond the viaduct; and this was true of vehicles ascending the hill.

The township requested that the dangerous condition at the viaduct be eliminated as far as possible, and in order to do so a new alignment of the road was decided upon, together with the cutting down of the hill, which resulted in a considerable improvement of the view under the viaduct. In all about 4,500 cubic yards of earth were moved.

The soil on the hill is of such a nature as to wash very readily, and on the section of the road from the pavement to the viaduct, a distance of about 600 feet, the macadam was made 16 feet wide, with grouted concrete gutters along both sides to take care of the water flowing down the hill. The remainder of the macadam was 12 feet wide. All of the macadam is 8 inches thick.

Stone for the improvement was furnished from the penitentiary at Menard, and the cost was paid from the township funds.

The following table is an itemized statement of the cost of this work:

Length of macadam	**1,920 feet**
Width of macadam: 1,020 ft.-12 ft. wide; 900 ft.-16 ft. wide.	
Macadam laid	**2,981 sq. yds.**
Amount of stone in road	**1,092 cu. yds.**
Average haul of stone	**¾ mile**

Rate of pay: Men, 20 cents; teams, 40 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 199.50
Excavation	1,978.30
Shaping road bed	147.00
Loading stone on wagons	121.50
Hauling stone, including rehandling	357.40
Spreading stone	103.70
Trimming shoulders and side roads	196.50
Rolling and sprinkling	174.50
Watchman and miscellaneous labor	29.90
Coal, oil and supplies	15.10
Freight on stone	989.46
Total	$4,312.86

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone on wagons	$0.111
Hauling stone, including rehandling	.327
Spreading stone	.094
Rolling and sprinkling	.160
Watchman and miscellaneous labor	.027
Coal, oil and supplies	.014
Total	$0.733

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.067
Excavation	.664
Shaping road bed	.049
Trimming shoulders and side roads	.066
Placing stone	.269
Freight on stone	.332
Total	$1.447

COST OF CURB AND GUTTER AT EDWARDSVILLE AVENUE.

Width, 4 feet; thickness, 6 inches.

109 cubic yards of stone @ $1.25 per cu. yd	$236.25
Cement, sand and water	363.44
Mixing and placing grouting	369.10
Total cost of 1,785-ft. curb and gutter	$968.79
Cost per lineal foot	$0.652

LEBANON.

PARTS OF ALTON, SUMMERFIELD AND BELLEVILLE STREET ROADS IN THE CITY OF LEBANON, ST. CLAIR COUNTY.

The Lebanon experiment was one which involved the use of two kinds of asphalt binder. The work was partly in the city of Lebanon, and partly in O'Fallon township adjoining the city of Lebanon. On Alton and Summerfield streets, the macadam was made 16 feet wide, and on Belleville street the macadam was made 27 feet wide between combined concrete curb and gutter. The macadam was made 9 inches

thick at the crown and 6 inches thick at the edges for both widths. The soil is a black loam, and the streets required a considerable amount of grading before stone could be placed.

Stone for the improvement was furnished from the penitentiary at Menard, and a part of it was shipped in and unloaded before construction work began. The cost was paid from the proceeds of a special assessment levied against the property abutting the streets.

The macadam was placed in two layers, the lower course being bonded with screenings. The upper course was made 3 inches thick and was thoroughly rolled before any binder was applied. The binder was applied with the special apparatus of the Illinois Highway Commission. Summerfield and Belleville streets were surfaced with bituminous binders No. 157 and 158. Alton street was surfaced with bituminous binders No. 155 and 156.

The following table is an itemized statement of the cost of this work:

Length of macadam	4,640 feet
Width of macadam: 1,500 ft.-30 ft. wide; 3,140 ft.-16 ft. wide.	
Macadam laid	10,402 sq. yds.
Amount of stone in road	3,952 cu. yds.
Amount of stone hauled from cars	1,757 cu. yds.
Amount of stone hauled from storage pile	2,195 cu. yds.
Average haul of stone	¾ mile
Amount of surface treated with bituminous binder	10,402 sq. yds.
Amount of bituminous binder used	77 tons
Rate of pay: Men, 25 cents; teams, 50 cents per hour.	

COST OF LABOR AND SUPPLIES.

Superintendence	$ 106.00
Excavation	962.50
Shaping road bed	256.50
Loading stone on wagons	405.50
Hauling stone, including rehandling	1,503.95
Spreading stone	456.50
Trimming shoulders and side roads	225.00
Rolling and sprinkling	227.50
Watchman and miscellaneous labor	248.93
Coal, oil and supplies	112.78
Applying bituminous binder	229.50
Cost of bituminous binder	1,753.45
Cost of culverts and storm water inlets	156.79
Contractor's profit	100.00
Cost of curb and gutter	1,204.75
Freight on stone	2,623.79
Total	$10,573.44

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone on wagons	$0.1020
Hauling stone, including rehandling	.3820
Spreading stone	.1155
Rolling and sprinkling	.0555
Watchman and miscellaneous labor	.0630
Coal, oil and supplies	.0290
Total	$0.7470

Edgewood bridge, Princeton Township, Bureau County.

The abutments for this bridge were constructed of reinforced concrete. The wings and main wall were designed as self-supporting cantilevers, the reinforcing steel being vertical. See Fig. 14 for typical design.

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.010
Excavation	.093
Shaping road bed	.025
Trimming shoulders and side roads	.022
Placing stone	.284
Applying bituminous binder, including cost of binder	.1906
Freight on stone	.252
Total	$0.8856

COST OF COMBINED CONCRETE CURB AND GUTTER, BELLEVILLE STREET, LEBANON, ST. CLAIR COUNTY.

Hauling cinders	$ 49.00
Excavation	70.50
Setting forms	115.50
Hauling stone	83.50
Mixing and placing	175.00
Cement, 708 sacks @ $1.43 per bbl	253.11
Lumber	24.25
Stakes	18.00
Miscellaneous	18.00
Sand	62.64
Superintendence	100.00
Freight on stone	90.00
Contractor's profit	144.75
Total	$1,204.75
Lineal feet of curb and gutter laid	2,895
Cost per lineal foot for curb and gutter	$0.416

COST OF CULVERTS AND STORM WATER INLETS.

Cement, 52 sacks	$18.59
Labor complete	44.00
Vitrified and cast iron pipe	94.20
Total	$156.79

O'FALLON.

NORTH DEPOT STREET ROAD, CITY OF O'FALLON, ST. CLAIR COUNTY.

During the season of 1910 the O'Fallon and Shiloh Valley road was constructed in this township, and the work was extended into the city of O'Fallon along south Depot street as far as the B. & O. railway.

During 1911, the village determined to extend this road through the city of O'Fallon along north Depot street to the north city limits. The work undertaken in 1911 began about 300 feet north of the B. & O. railroad track at the north line of Main street, and extended along Main street to the city limits a distance of 2,525 feet; the improvement being bituminous macadam 16 feet wide and 9 inches thick at the crown and 6 inches thick at the shoulder.

Stone for the work was furnished from the penitentiary at Menard, and the cost was paid by the city of O'Fallon. The soil is a black,

sticky loam. The street was comparatively level, there being only a very small amount of shaping to be done before the stone was placed. On this work the first spreading of bituminous binder was No. 135, and the final spreading or seal coat was No. 156. The binder was applied with the special apparatus of the Illinois Highway Commission.

The following table is an itemized statement of the cost of the work:

Length of macadam	2,525 feet
Width of macadam	16 feet
Macadam laid	4,488 sq. yds.
Amount of stone in road	1,321 cu. yds.
Amount of stone hauled from cars	529 cu. yds.
Amount of stone hauled from storage pile	792 cu. yds.
Average haul of stone	½ mile
Amount of surface treated with bituminous binder	4,488 sq. yds.
Amount of bituminous binder used	8,800 gallons

Rate of pay: Men, 35 cents; teams, 50 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 102.00
Excavation	108.80
Shaping road bed	25.30
Loading stone on wagons	201.70
Hauling stone, including rehandling	517.10
Spreading stone	136.55
Trimming shoulders and side roads	48.50
Rolling and sprinkling	164.50
Watchman and miscellaneous labor	104.40
Coal, oil and supplies	18.45
Applying bituminous binder	149.59
Cost of bituminous binder	676.90
Freight on stone	1,185.00
Total	$3,438.79

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone on wagons	$0.153
Hauling stone, including rehandling	.392
Spreading stone	.103
Rolling and sprinkling	.125
Watchman and miscellaneous labor	.078
Coal, oil and supplies	.014
Total	$0.865

COST PER SQUARE YARD FINISHED BITUMINOUS MACADAM.

Superintendence	$0.023
Excavation	.024
Shaping road bed	.005
Trimming shoulders and side roads	.011
Placing stone	.255
Applying bituminous binder, including cost of binder	.184
Freight on stone	.264
Total	$0.766

OILED EARTH CONSTRUCTION.

VIRGINIA.

CHANDLERVILLE ROAD, ROAD DISTRICTS NOS. 3 AND 6, CASS COUNTY.

The Virginia construction was an oiled earth road experiment. The work began at the corner of the public square in Virginia and extended on Main street to the cemetery, a distance of about one mile. The country is slightly rolling and only a small amount of grading was necessary. Practically all common types of Illinois soil were found on this road. Funds for the experiment were furnished in part by the road district commissioners, and in part by the business men of the city of Virginia.

About 16 feet of the middle portion of the road was treated with oil. This portion of the road was plowed up and pulverized with a roller and disc harrow, and the pulverized earth moved out to the side of the road. The foundation was then thoroughly tamped with a ten ton steam roller, and the oil and earth applied in alternate layers. The earth was then thoroughly watersoaked and mixed with a disc harrow and compacted with a rolling tamper. The work was completed rather late in the fall and did not thoroughly dry out before freezing weather. The oil used was an asphaltic residuum, having a specific gravity of 12°—14° Beaume and is given in the table as Nos. 132, 133 and 134.

The following table gives an itemized statement of the cost of this work:

Length of road	5,600 feet
Width of road	16 feet
Surface treated	9,956 sq. yds.
Bituminous binder used	19,457 gallons
Average haul of tank wagon	⅞ mile

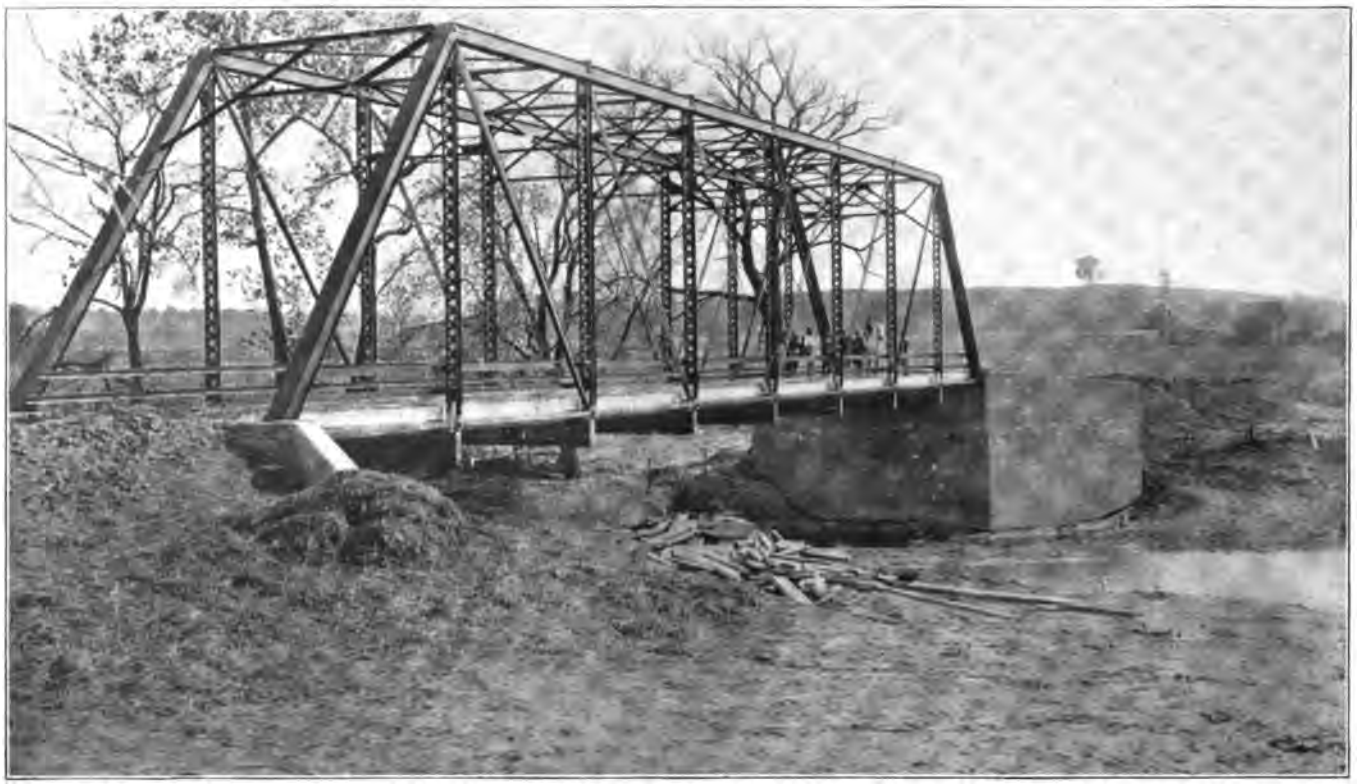
Rate of pay: Men, 20 cents; teams, 35 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 90.00
Excavation	233.91
Shaping road bed	60.60
Trimming shoulders and side roads	46.20
Placing, mixing and tamping	237.65
Rolling	22.50
Watchman and miscellaneous labor	18.20
Coal, oil and supplies	40.50
Heating bituminous binder	70.90
Hauling and spreading bituminous binder	38.30
Cost of bituminous binder delivered	729.64
Total	$1,588.40

COST PER GALLON FOR APPLYING OIL.

Heating	$0.00364
Hauling and distributing	.00196
Total	$0.00560



Edgewood bridge, Princeton Township, Bureau County.

Pin connected, steel bridge with reinforced concrete floor. Span, 150 feet; roadway, 18 feet; height of foundations, 23 feet. Built in 1912. Cost, $7,038.00. H. S. Wetherell, Morgan Park, Illinois, contractor. Designed by the Illinois Highway Commission.

COST PER SQUARE YARD FINISHED ROAD.

Superintendence	$0.00903
Excavation	.02349
Shaping road bed	.00608
Trimming shoulders and side roads	.00460
Applying oil	.01096
Mixing and tamping earth	.02386
Rolling	.00226
Coal, oil and supplies	.00406
Cost of oil	.07228
Watchman and miscellaneous labor	.00183
Total	$0.15845

MAINTENANCE WORK, 1911.

BEARDSTOWN.

BEARDSTOWN-VIRGINIA ROAD, ROAD DISTRICT NO. 3, CASS COUNTY.

In 1910 an asphalt macadam was constructed on this road and the asphalt was applied by the penetration method, using hand spreading cans. The surface obtained was unsatisfactory, due in part to the method of spreading the asphalt and due in part to the fact that the surface was choked up too much before the asphalt was applied. Under traffic the surface became very uneven, being a succession of ridges and hollows.

While the State outfit was in Beardstown working on the Chandlerville road, it was decided to improve the surface of the Virginia road. Investigation showed that the unevenness was due principally to excess of asphalt, and in making the repairs this excess was scraped off with a sharp grader drawn with an engine. The surface was then painted with approximately one-fourth gallon of asphalt per square yard of surface. The amount applied varied considerably from section to section, it being heavier on the bare sections, while none at all was applied where the stone was already sufficiently covered. The binder was applied with the special apparatus of the Illinois Highway Commission.

After the asphalt was spread, the surface was covered lightly with coarse sharp gravel. The road was originally constructed with binder No. 154 and was resurfaced with binder No. 146.

The following table gives the cost of the surfacing:

Length of macadam	5,469	feet
Width of macadam	12	feet
Macadam resurfaced	7,292	sq. yds.
Amount of gravel used in resurfacing	96.83	tons
Average haul of stone	1½	miles
Amount of surface treated with bituminous binder	7,292	sq. yds.
Amount of bituminous binder used	1,750	gallons

Rate of pay: Men, 20 cents; teams, 35 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 27.00
Hauling gravel	68.35
Spreading gravel	27.94
Rolling	21.00
Coal, oil and supplies	8.28
Applying bituminous binder	37.85
Cost of bituminous binder	105.00
Watchman and miscellaneous labor	1.75
Cost of gravel for surface dressing	101.69
Total	$398.86
Cost per gallon for applying bituminous binder	$0.0216

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.0040
Placing stone	.0175
Applying bituminous binder, including cost of binder	.0195
Cost of gravel for surface dressing	.0140
Total	$0.0550

FLOSSMOOR.

FLOSSMOOR ROAD, RICH TOWNSHIP, COOK COUNTY.

During 1909, an experimental tar macadam was constructed at Flossmoor, a description of which will be found in the third report of the commission. Frequent inspections were made of this road after its completion, and in 1910 it was noted that some sections of the macadam were ravelling. During the early part of 1911 large quantities of building materials were hauled over one end of this road for use in a new addition which was being laid out, and the effect of the heavy hauling was to ravel the macadam badly, and resurfacing became necessary. The ravelling did not take place throughout the entire length of the macadam, but was found to exist in short stretches throughout about one-half mile of the macadam. Where the macadam had not ravelled, it had became somewhat rough because the tar had worn off the surface, leaving the stone entirely bare, and in a great many places the screenings and chips had come out of the surface voids, making the surface rough and unpleasant to travel. In the resurfacing, those portions of the road that had not ravelled were given a paint coat of tar, followed by a covering of coarse limestone chips. The sections of the macadam that had ravelled were scarified and reshaped with what new material was necessary, rolled and finished with tar in the same manner that a new macadam would be surfaced.

The treatment from section to section of the road varied on account of the condition of the macadam and the quantity of the tar which was used in the surfacing varies throughout, according to the requirements of the surface. The binder was applied with the special apparatus of the Illinois Highway Commission.

On those portions of the road which only required a surface dressing approximately one-half gallon per square yard of tar was used, while on those sections which had ravelled and were reconstructed about two gallons per square yard of tar No. 169 was used.

The following table is an itemized statement of the cost of this work:

Length of macadam	5,300 feet
Width of macadam	12 feet
Macadam resurfaced	6,130 sq. yds.
Amount of stone used in resurfacing	74 cu. yds.
Amount of stone hauled from cars	74 cu. yds.
Average haul of stone	⅜ mile
Amount of surface treated with bituminous binder	7,070 sq. yds.
Amount of bituminous binder used	4,115 gallons

Rate of pay: Men, 20 cents; teams, 60 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 48.00
Unloading stone into storage	10.00
Cleaning road	6.90
Loading stone on wagons	2.00
Hauling stone	34.30
Spreading stone	4.50
Watchman and miscellaneous labor	80.45
Rolling and sprinkling	54.00
Coal, oil and supplies	37.97
Applying bituminous binder	27.24
Cost of bituminous binder	321.20
Freight on stone	73.23
Total	$699.79
Total cost per square yard	$0.114
Cost per square yard per year	$0.057

DWIGHT.

MAZON AVENUE, DWIGHT TOWNSHIP, LIVINGSTON COUNTY.

The Mazon avenue macadam road was constructed during 1909. Blocks 1 and 2 were surfaced with tar. Blocks 3 and 4 were surfaced with a liquid asphalt. When inspected in 1911, blocks 3 and 4 were in poor condition, block 3 particularly being very uneven. The asphalt in this block had continually sweat on the surface and had been repeatedly covered with screenings in order to take up the surplus oil. Eventually the stone was covered with a thick uneven layer of this mixture of asphalt and chips, which made the surface very uneven and unpleasant to travel. Block 4, which was surfaced with the same material, had also become somewhat uneven from the repeated covering of the asphalt that had worked out on top of the stone. Blocks 1 and 2 were in very good condition, except that in a few places the stone had begun to break out of the surface, and these spots were beginning to ravel. On both these blocks the surface stone was bare, the tar being worn down to the stone.

Bridge No. 4, Cahokia Drainage Canal, Edwardsville Township, Madison County.

A steel bridge with reinforced concrete floor, on plain concrete foundations. Two end spans, 60 feet; center span, 150 feet; roadway, 20 feet. Piles were used to support the piers of all these bridges. Built in 1911. Four bridges like this were built at a total cost of $53,475.00. Joliet Bridge & Iron Company, Joliet, Illinois, contractors. Designed by the Illinois Highway Commission.

It was decided to resurface blocks 1 and 2 with a paint coat of light tar; to remove the entire surface of block 3, and put on a new layer of stone and resurface with asphalt, and to scrape the surplus from block 4 and give it a paint coat of asphalt.

Blocks 1 and 2 were swept with a street sweeper to remove all the detritus, all uneven places were loosened up and brought to a proper surface, and the entire macadam was given a one-half gallon per square yard paint coat of a light tar. Block 3 was found to be in such a bad condition that about 4 inches of the surface was removed, the foundation rolled, and a new surface layer of stone placed. This new layer of stone, after being rolled, was from 2½ to 3½ inches in thickness. It was surfaced with two gallons per square yard of heavy asphalt, put on in two applications. Block 4 was found to need only surface dressing, and was cleaned, scraped and all bare places painted with asphalt. The binder was applied with the special apparatus of the Illinois Highway Commission.

Binder No. 161 was used in painting blocks 1 and 2. Binders No. 153 and 160 were used on blocks 3 and 4.

The following statement is an itemized account of the cost of this work:

Length of macadam	2,880 feet
Width of macadam: 1,340 ft.-21 ft. wide; 1,540 ft.-26 ft. wide.	
Macadam resurfaced	7,600 sq. yds.
Amount of stone in road	314 cu. yds.
Amount of stone hauled from storage pile	314 cu. yds.
Average haul of stone	½ mile
Amount of surface treated with bituminous binder	7,600 sq. yds.
Amount of bituminous binder used:	
Tarvia B	1,165 gallons
Pioneer	2,044 gallons
Rate of pay: Men, 25 cents; teams, 50 cents per hour.	

COST OF LABOR AND SUPPLIES.

Superintendence	$ 72.00
Removing old top	87.92
Cleaning and sweeping	20.75
Hauling stone, including rehandling and loading	131.77
Spreading stone	45.94
Watchman and miscellaneous labor	27.89
Rolling and sprinkling	9.90
Coal, oil and supplies	22.97
Applying bituminous binder	84.89
Cost of bituminous binder	334.68
Freight on stone	268.86
Total	$1,107.57

COST PER SQUARE YARD FOR RESURFACING.

Superintendence	$0.0095
Removing old top	.0120
Cleaning and sweeping	.0030
Cost of binder	.0440
Placing stone	.0315
Applying bituminous binder, including cost of binder	.0110
Freight on stone	.0350
Total	$0.1460
Cost per square yard per year	$0.073

HIGHLAND.

TRENTON ROAD, HELVETIA TOWNSHIP, MADISON COUNTY.

The Trenton road was constructed in the fall of 1908 as a water-bound macadam from stone furnished by the penitentiary at Menard. On account of improper construction, the road did not hold its shape. Deep ruts and depressions had formed and the surface was uneven and disagreeable to travel.

In 1911 it was decided to resurface this road and the entire surface was spiked up, reshaped and new material added where necessary. It was then thoroughly rolled and bonded with screenings and water.

The following table is an itemized statement of the cost of resurfacing this road:

Length of macadam	5,300 feet
Width of macadam	12 feet
Macadam laid	7,110 sq. yds.
Amount of stone in road	80 cu. yds.
Amount of stone hauled from storage pile	80 cu. yds.
Average haul of stone	¾ mile

Rate of pay: Men, 17½ cents; teams, 40 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$21.00
Loading and hauling stone, including rehandling	73.37
Spreading stone	71.14
Rolling and sprinkling	45.00
Coal, oil and supplies	9.93
Watchman and miscellaneous labor	22.08
Freight on stone	48.00
Total	$290.52

COST PER SQUARE YARD FOR RESURFACING.

Superintendence	$0.003
Placing stone	.031
Freight on stone	.007
Total	$0.041
Cost per square yard per year	$0.014

EXPERIMENTAL ROADS CONSTRUCTED IN 1912.

CAIRO.

CAIRO-WILLARD ROAD, ROAD DISTRICT NO. 7, ALEXANDER COUNTY.

Gravel roads made of a local bank gravel had been constructed along the Cairo-Willard road in Road District No. 7, northward from the city of Cairo for a distance of six or seven miles, and the macadam constructed in 1912 on this road began at the north end of this gravel road and extended in a northerly direction for a distance of one mile.

The soil upon which the road was constructed is a light black loam, characteristic of the soils near the Mississippi River. The improvement consisted of a waterbound macadam road 12 feet wide and 8 inches thick. Stone for the improvement was furnished from the penitentiary at Menard, and a part was shipped in and unloaded before work began. A large part of the stone was placed on the roadway before any of the macadam was rolled and finished, and heavy rains occurring about the time the finishing was begun, interfered somewhat with the proper rolling of the stone. After the macadam had been completed, it was found advisable to surface it with the local bank gravel.

The following table is an itemized statement of the cost of this work:

Length of road	5,280 feet
Width of macadam	12 feet
Macadam laid	7,040 sq. yds.
Stone in road	2,520 cu. yds.
Stone hauled from cars	1,500 cu. yds.
Stone hauled from storage	1,020 cu. yds.
Average haul of stone	1 mile
Rate of pay: Men, 15 cents; teams, 35 cents per hour; spreading binder, men, 25 cents per hour.	

COST OF LABOR AND SUPPLIES.

Superintendence	$ 139.00
Shaping road bed	124.70
Loading stone	156.31
Hauling stone, including rehandling	897.23
Spreading stone	153.55
Rolling and sprinkling	120.00
Miscellaneous labor	138.80
Coal, oil and supplies	36.67
Freight on stone	1,159.25
Cost of bonding gravel placed on road	350.00
Total	$3,275.51

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone on wagons	$0.0620
Hauling stone, including rehandling	.3560
Spreading stone	.0608
Rolling and sprinkling	.0476
Watchman and miscellaneous labor	.0550
Coal, oil and supplies	.0145
Total	$0.5959

COST PER SQUARE YARD FINISHED WATERBOUND MACADAM.

Superintendence	$0.0197
Shaping road bed	.0177
Placing stone	.2134
Freight on stone	.1647
Cost of applying bonding gravel	.0497
Total	$0.4652

A steel leg bridge incased in concrete.

This view is shown to illustrate the folly of building a bridge without wings or end walls long enough amply to support the approach fills. In order to avoid a serious obstruction of the waterway by the approach fills, logs and plank were braced against the wings with the result shown in this picture. It will be but a short time before dangerous holes will occur in the roadway near the concrete wings. Contrast this bridge with those shown in plates 28 and 30.

Cairo.

CAIRO-MOUND CITY ROAD, ROAD DISTRICT NO. 7, ALEXANDER COUNTY.

The improvement of the Cairo and Mound City road began at the north end of the pavement in Beecher City and extended in a northerly direction for a distance of 5,250 feet. The road which was improved was a wide gravel road, but on account of the excessive amount of automobile traffic, it was not entirely satisfactory in wet weather. The road was improved by the construction of a bituminous surface on the old gravel road. This bituminous surface was made by placing a layer of stone 4 inches thick on top of the gravel and filling this layer of stone with a bituminous compound. The road was level, but the roadbed was very hard on account of the well compacted gravel so that a considerable amount of work was necessary to shape the roadbed. After the stone was placed and rolled, it was partially filled with limestone chips, which were brushed into the interstices in the surface. The surface was then covered with a spreading of bituminous compound and again covered lightly with limestone chips which were brushed into the interstices in the surface. A second spreading of the bituminous compound was then applied and the surface dressed with coarse sand. Three different consignments of bituminous compound were used on this road as follows:

Station 0 to station 20, binder No. 319; station 20 to station 36, binder No. 318; station 36 to station 52, binder No. 311.

The following table is an itemized statement of the cost of this work:

Length of road	5,250	feet
Width of macadam	16	feet
Macadam laid	9,334	sq. yds.
Stone in road	1,384	cu. yds.
Stone hauled from cars	1,384	cu. yds.
Average haul of stone	¾	mile
Surface treated with bituminous binder	9,334	sq. yds.
Bituminous binder used	26,100	gallons
Average haul of tank wagon	¾	mile
Rate of pay: Men, 15 cents; teams, 35 cents per hour.		
Amount of tar binder used per square yard surface	2.8	gallons

COST OF LABOR AND SUPPLIES.

Superintendence	$ 154.50
Shaping road bed	77.90
Loading stone	107.55
Hauling stone and sand, including rehandling	409.25
Spreading stone	109.05
Trimming shoulders and side roads	31.75
Rolling and sprinkling	115.50
Watchman and miscellaneous labor	87.35
Coal, oil and supplies	56.11
Heating bituminous binder	75.00
Hauling and spreading bituminous binder	192.05
Cost of bituminous binder delivered	1,847.78
Freight on stone	931.00
Cost of coarse sand for surface	31.00
Total	$4,225.79

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone on wagons	$0.078
Hauling stone, including rehandling	.295
Spreading stone	.079
Rolling and sprinkling	.084
Watchman and miscellaneous labor	.063
Coal, oil and supplies	.040
Total	$0.639
Cost per gallon for applying binder (heating, hauling and spreading)	$0.0102

COST PER SQUARE YARD FINISHED BITUMINOUS MACADAM.

Superintendence	$0.0166
Shaping road bed	.0083
Trimming shoulders and side roads	.0034
Placing stone	.0945
Applying bituminous binder	.0286
Cost of bituminous binder	.1980
Freight on stone	.1000
Gravel for surface dressing	.0033
Total	$0.4527

CAIRO.

HALF-WAY ROAD, ROAD DISTRICT NO. 7, ALEXANDER COUNTY.

The Half-way road is a road used as a cut-off between the Cairo and Mound City road and the Cairo and Willard road. The improvement began at the intersection of this cross road with the Cairo and Mound City road and extended in a westerly direction for a distance of 2,600 feet. The country is very flat and no excavation was necessary except a little to widen places where the existing road was somewhat too narrow. The soil is a black loam.

Stone for the improvement was furnished from the penitentiary at Menard and a part was shipped in and unloaded before the work of construction began. The undertaking was financed by the district highway commissioners and paid mostly from the regular road and bridge tax. The improvement consisted in the construction of a water-bound macadam 12 feet wide and 8 inches thick.

The following table is an itemized statement of the cost of this work:

Length of road	2,600 feet
Width of macadam	12 feet
Macadam laid	3,470 sq. yds.
Stone in road	1,200 cu. yds.
Stone hauled from cars	753 cu. yds.
Stone hauled from storage	447 cu. yds.
Average haul of stone	⅛ mile

Rate of pay: Men, 15 cents; teams, 35 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$103.50
Excavation	38.20
Shaping road bed	61.15
Loading stone	89.85
Hauling stone, including rehandling	308.80
Spreading stone	64.65
Trimming shoulders and side roads	12.85
Rolling and sprinkling	105.15
Watchman and miscellaneous labor	18.70
Coal, oil and supplies	46.18
Freight on stone	619.88
Total	$1,468.91

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone on wagons	$0.075
Hauling stone, including rehandling	.257
Spreading stone	.054
Rolling and sprinkling	.088
Watchman and miscellaneous labor	.015
Coal, oil and supplies	.038
Total	$0.527

COST PER SQUARE YARD FINISHED WATERBOUND MACADAM.

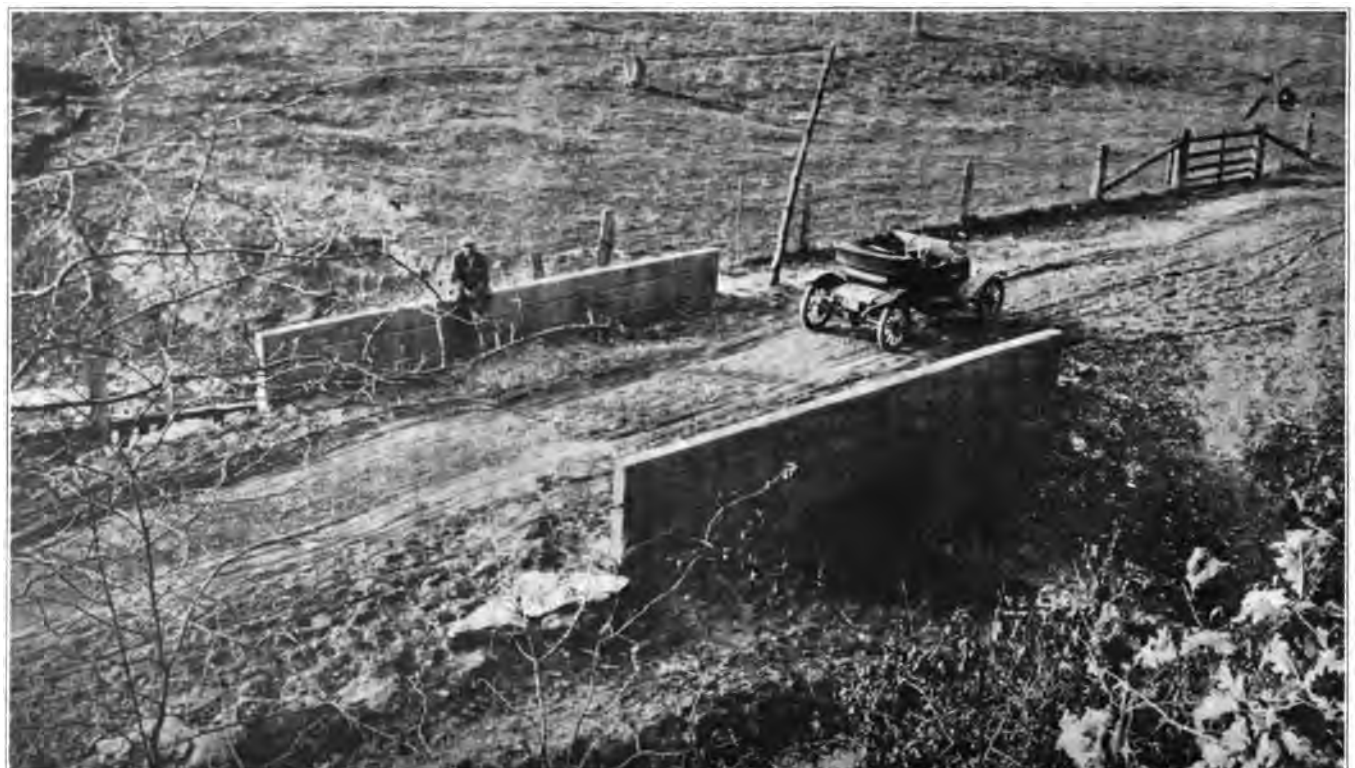
Superintendence	$0.0297
Excavation	.0110
Shaping road bed	.0175
Trimming shoulders and side roads	.0018
Placing stone	.1820
Freight on stone	.1780
Total	$0.4200

CHANDLERVILLE.

CHANDLERVILLE-BEARDSTOWN ROAD, CHANDLERVILLE TOWNSHIP, CASS COUNTY.

The Chandlerville-Beardstown road improvement consists of a section of concrete road constructed over a particularly sandy piece of road just outside the village of Chandlerville. The work was done very largely by subscriptions and the cost data herewith given is made up on a basis of the day labor price for this subscription work, which in many cases was more than the work was worth on account of its intermittent nature.

The pavement constructed is a concrete roadway 16 feet wide and is 6 inches thick, gravel being used for the concrete.



Bell bridge, Alsey Township, Scott County.

Span, 8 feet; roadway, 20 feet; clear height, 4 feet, 4 inches. Built in 1912. Cost, $293.00. Illinois Steel Bridge Company, Jacksonville, Illinois, contractors. This is a reinforced concrete, paved box culvert with reinforced concrete end walls. Note the ample protection afforded to traffic by the end walls which are carried up above the roadway to form rails. Note also, that the end walls are long enough so that the material of the approach fills may take a natural slope to the edge of the stream, without obstructing the waterway.

The following table is an itemized statement of the cost of this work:

Amount of pavement laid	1,470 sq. yds.
Thickness of pavement	6 inches
Width of pavement	16 feet
Length of haul for materials	½ mile
Cost of cement per barrel	$1.13 and $1.20
Amount of cement per square yard of pavement	0.31 bbl.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 50.00
Excavation (donation value estimated)	71.73
Shaping road bed	29.75
Loading and hauling stone and gravel	173.21
Mixing and placing concrete	155.08
Cost of sand and stone	370.85
Cost of cement	553.03
Total	$1,403.65

COST PER SQUARE YARD FOR LABOR AND SUPPLIES.

Superintendence	$0.034
Excavation (donation value estimated)	.048
Shaping road bed	.020
Loading and hauling stone and gravel	.118
Mixing and placing concrete	.105
Cost of stone and gravel	.257
Cost of cement	.378
Total	$0.960

MATTOON.

WESTERN AVENUE ROAD, MATTOON TOWNSHIP, COLES COUNTY.

The Western avenue road improvement began at the west end of the pavement on Western avenue and extended in a westerly direction from the city limits of Mattoon for a distance of one mile. The country is level, and the road required only a comparatively small amount of grading. The soil is a black sticky loam. Stone for the improvement

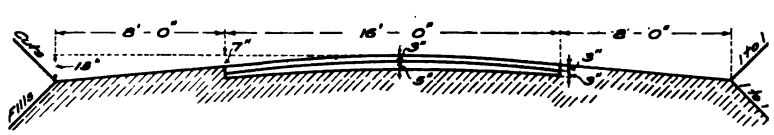


FIG. 7. Cross section of Western avenue road, Mattoon.

was furnished from the penitentiary at Menard and the improvement consisted in the construction of a bituminous macadam roadway 16 feet wide and 8 inches thick at the crown and 6 inches thick at the edge. The stone was in part unloaded in a storage pile in the early spring and in part hauled directly from the cars.

The work was interfered with considerably by wet weather which made it impossible to do the most economical bituminous work. The

gravel which was used in the bituminous construction was obtained at Riverside, Indiana. The cost was paid from funds obtained in part from the township and in part from those living along the road.

The bituminous binder was applied after the road had been thoroughly rolled, and consisted of a first application of about one gallon per square yard of surface made up of one-third of binder No. 179 and two-thirds of binder Nos. 247, 248 or 245. After this spreading of bituminous binder, the surface of the road was covered with gravel which was carefully brushed into the voids in the surface and rolled once over. The road was then covered with a spreading of bituminous binder made up of one part of binder No. 179 and eight parts of binder No. 281.

From station 0 to station 18, and from stations 40 to 46, a third application of bituminous compound was applied at the rate of about one-fourth gallon per square yard of surface. This paint coat consisted of equal parts of binders Nos. 179 and 245. The entire surface was covered with torpedo sand.

The following table is an itemized statement of the cost of the work:

Length of road	5,280 feet
Width of macadam	16 feet
Macadam laid	9,387 sq. yds.
Stone in road	2,680 cu. yds.
Stone hauled from cars	1,780 cu. yds.
Stone hauled from storage	900 cu. yds.
Average haul of stone	1 mile
Surface treated with bituminous binder	9,387 sq. yds.
Bituminous binder used	23,500 gallons

Rate of pay: Men, 20 cents; teams, 40 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 264.00
Excavation	453.60
Shaping road bed	235.35
Loading stone	287.60
Hauling stone, including rehandling	1,040.23
Spreading stone	553.60
Trimming shoulders and side roads	35.50
Rolling and sprinkling	239.00
Watchman and miscellaneous labor	333.15
Coal, oil and supplies	152.64
Heating, hauling and spreading bituminous binder	253.17
Cost of bituminous binder delivered	1,757.00
Freight on stone	2,918.80
Cost of gravel for surface dressing	135.05
Total	$8,658.69
Amount of binder used per square yard of surface	2.5 gallons

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone on wagons	$0.107
Hauling stone, including rehandling	.388
Spreading stone	.207
Rolling and sprinkling	.090
Watchman and miscellaneous labor	.125
Coal, oil and supplies	.057
Total	$0.974

Cost per gallon for applying binder (heating, hauling and spreading)	$0.0108

COST PER SQUARE YARD FINISHED BITUMINOUS MACADAM.

Superintendence	$0.0281
Excavation	.0484
Shaping road bed	.0250
Trimming shoulders and side roads	.0040
Placing stone	.2776
Applying bituminous binder	.0270
Cost of bituminous binder	.1875
Freight on stone	.3110
Gravel for surface dressing	.0144
Total	$0.9230

DATA ON COST HAULING WITH TRACTOR OUTFIT AT MATTOON.

AVERAGE LENGTH OF HAUL, ONE MILE.

No. of cubic yards hauled by engine	674
No. of cubic yards hauled by teams	2,170
No. of days outfit was on job	22
No. of days outfit hauled (fractions counted as full)	13½

COSTS.

Cost to Illinois Highway Commission for engine operator (salary and expenses, straight time)	$66.00
Cost of fireman (actual days worked)	27.00
Coal, oil and supplies	51.00
Maintenance of outfit	26.00
Total	$170.00
Total cost per cubic yard for hauling	$0.258
Cost per cubic yard to township for hauling	.115
Cost per cubic yard to State for hauling	.143
(Actual cost of team hauling on same work and same haul)	.435
Cost of hauling by engine per cubic yard mile	.258
Cost of hauling by teams per cubic yard mile	.435

DETAILED COSTS OF ENGINE HAULING PER CUBIC YARD MILE.

Operator	$0.098
Fireman	.042
Coal, oil, etc	.077
Maintenance	.041
Total	$0.258

SHERMERVILLE.

GLENVIEW AVENUE ROAD, NORTHFIELD TOWNSHIP, COOK COUNTY.

The improvement on the Northfield avenue road began about one mile and a half northeast of the village of Shermerville on the road known as Glenview avenue, and extended in a northerly direction for a

A. St. Paul bridge, Salem Township, Carroll County.

Span 32 feet; roadway 16 feet; height of foundations 17½ feet. Built in 1911. Cost, $1,401.80. G. E. Hungerford, Mt. Carroll, Illinois, contractor. Designed by the Illinois Highway Commission.

B. Old St. Paul bridge, Salem Township, Carroll County.

This menace to public safety was replaced by the modern reinforced concrete bridge shown above.

distance of 4,200 feet. The country is somewhat rolling so that a considerable amount of excavation was done in shaping the road for the improvement. The soil is a black loam.

Stone for the improvement was furnished from the penitentiary at Joliet, and the cost was paid from funds derived from the special hard road tax and the work was done under a no-profit form of contract. The improvement consisted in the construction of a water-bound macadam, 12 feet wide and 8 inches thick. The surface was bonded with water and screenings and then dressed with about ½ inch of bonding gravel obtained from a local gravel pit.

The following table is an itemized statement of the cost of this work:

Length of road	4,200 feet
Width of macadam	12 feet
Macadam laid	5,600 sq. yds.
Stone in road, including bonding gravel	2,000 cu. yds.
Stone hauled from cars	2,000 cu. yds.
Average haul of stone	1 mile

Rate of pay: Men, 25 cents; teams, 40 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$138.00
Excavation	359.25
Shaping road bed	143.63
Hauling stone, including rehandling	791.25
Spreading stone	185.78
Trimming shoulders and side roads	77.30
Rolling and sprinkling	92.50
Watchman and miscellaneous labor	24.17
Coal, oil and supplies	76.97
Hauling gravel binder	143.75
Cost of gravel binder	50.00
Freight and car service on stone	742.75
Total	$2,825.35

COST PER CUBIC YARD FOR PLACING STONE.

Unloading stone from cars, hauling stone, including rehandling	$0.3950
Spreading stone	.0928
Rolling and sprinkling	.0462
Watchman and miscellaneous labor	.0120
Coal, oil and supplies	.0385
Hauling gravel binder	.0720
Total	$0.6565

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.0245
Excavation	.0640
Shaping road bed	.0256
Trimming shoulders and side roads	.0138
Placing stone and gravel binder	.2347
Freight on stone	.1325
Cost of gravel binder at pit	.0089
Total	$0.5040

PALESTINE.

PALESTINE-HUTSONVILLE ROAD, LA MOTTE TOWNSHIP, CRAWFORD COUNTY.

The Palestine-Hutsonville road begins at the northerly city limits of the city of Palestine, and extends in a northerly direction for a distance of 7,920 feet. The road runs through a comparatively level country, and the soil is of a sandy nature. Only a small amount of excavation was required to put the road in shape for the stone, and that was done in widening an embankment through the creek bottoms just north of Palestine.

The improvement consisted in the construction of a waterbound macadam, 12 feet wide and 6 inches thick. Stone for the improvement was furnished from the penitentiary at Menard and was shipped in and hauled directly from the cars, except a small amount which was unloaded before the construction was begun. The work at Palestine was done early in the season at a time when a large amount of labor was available, and as a result it was possible to do the work very economically.

The following table is an itemized statement of the cost of this work:

Length of macadam	7,920 feet
Width of macadam	12 feet
Macadam laid	10,560 sq. yds.
Amount of stone in road	2,738 cu. yds.
Average haul of stone	1 mile

COST OF LABOR AND SUPPLIES.

Superintendence	$ 58.00
Excavation	34.50
Shaping road bed	111.35
Loading and hauling stone, including rehandling	1,031.81
Spreading stone	213.95
Trimming shoulders and side roads	25.35
Rolling and sprinkling	103.50
Coal, oil and supplies	46.64
Freight on stone and car service	2,920.40
Total	$4,546.50

COST PER CUBIC YARD FOR PLACING STONE.

Hauling stone, including rehandling	$0.3780
Spreading stone	.0782
Rolling and sprinkling	.0378
Coal, oil and supplies	.0171
Total	$0.5111

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.0055
Excavation	.0032
Shaping road bed	.0105
Trimming shoulders and side roads	.0024
Placing stone	.1320
Freight on stone	.2760
Total	$0.4296

DeKalb.

SYCAMORE-DE KALB ROAD, DE KALB TOWNSHIP, DE KALB COUNTY.

The Sycamore-DeKalb road improvement consisted in the construction of a concrete pavement on the Sycamore road extending in a northerly direction for a distance of one mile from the C. M. & G. railway crossing. The country is fairly level, and only a small amount of earth work was necessary. The soil is a black loam and clay, and the road was well drained. The concrete roadway was made 12 feet wide and 6½ inches thick with macadam shoulders 2 feet wide on each side of the concrete roadway. The concrete was made of gravel and sand which was purchased in the market and the cost of the entire improvement was paid from the regular road and bridge fund.

A part of this road was reinforced with ½-inch square twisted 10 foot bars placed crosswise of the pavement, and a part of the road was reinforced with No. 26 A wire mesh made by the American Steel & Wire Company. The mesh is made up of No. 6 wire with 2-inch mesh, and was in strips 34 inches wide, which were laid crosswise of the road overlapping about 2 inches.

Beginning with the section ending at station 27+45 and continuing to the section ending at station 11+65, the reinforced sections alternate with plain concrete sections as follows:

The sections are numbered at the edge near the expansion joint and each section is the part of the pavement between two expansion joints. The various sections follow each other in the following order and are numbered as here given:

No. 1. Reinforced crosswise with ½-inch bars 2 feet center to center, 12 sections.

No. 2. Reinforced crosswise with ½-inch bars 4 feet center to center, 12 sections.

No. 3. Plain concrete, 12 sections.

No. 4. Reinforced with No. 26 A wire mesh, four sections.

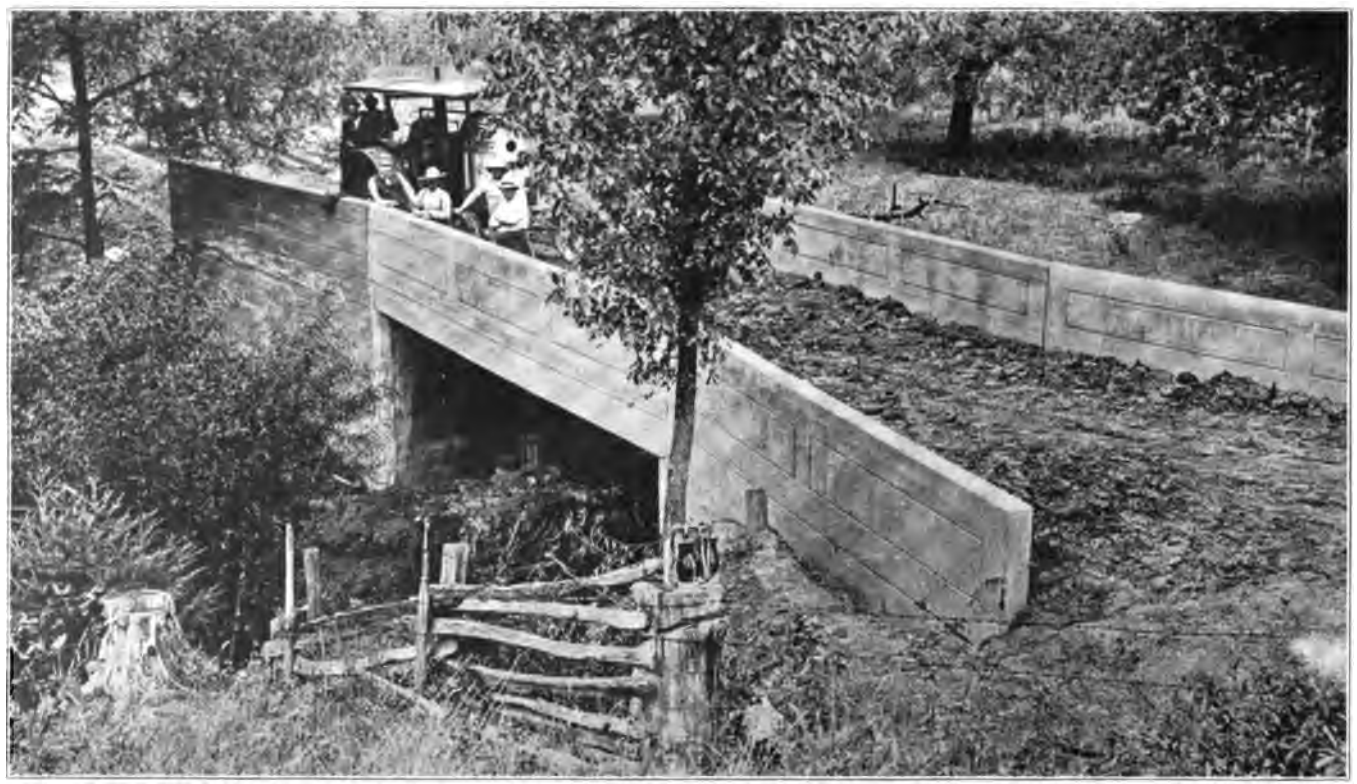
The mesh reinforcement cost $1.84 per square of 100 square feet. The bar reinforcement cost 2 cents per pound, f. o. b. Chicago Heights, or 16.8 cents per bar 10 feet long at DeKalb.

The following table is an itemized statement of the cost of this work:

Amount of pavement laid	7,334 sq. yds.
Thickness of pavement	6½ inches
Width of pavement	12 feet
Length of haul for materials	½ mile
Cost of cement per barrel	$0.55
Amount of cement used per square yard of pavement	0.31 bbl.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 200.00
Excavation	900.02
Shaping road bed	69.75
Trimming shoulders and side roads	72.60
Loading and hauling sand and stone, including rehandling	596.02
Mixing and placing concrete	746.65
Watchman and miscellaneous labor	187.07



White bridge, North East Township, Adams County.

Span, 25 feet; roadway, 16 feet; finished roadway to bottom of footings, 18 feet. Built in 1912. Cost, $1,235.00. Ruprecht Voirol Construction Company, St. Louis, Missouri, contractor. A reinforced concrete, slab bridge with wings built at an angle of 10 degrees with the axis of the roadway. The wings are tied together at intervals with steel rods buried in concrete, about three feet below the roadway surface. The rails are continued to the ends of the wings, thus affording ample protection to traffic. Designed by the Illinois Highway Commission.

Cost of sand and stone f.o.b. DeKalb	$1,671.00
Cost of cement f.o.b. DeKalb	1,250.00
Expansion joints	160.13
Reinforcing steel (bars, $294.00; mesh, $42.93)	336.93
Coal and oil for mixer and miscellaneous supplies	32.00
Forms and other lumber	119.77
Car fares for men	51.16
Pay for time of men coming and going	138.25
Total	$6,531.35

COST PER SQUARE YARD FOR LABOR AND SUPPLIES.

Superintendence	$0.0273
Excavation	.1227
Shaping road bed	.0095
Trimming shoulders and side roads	.0099
Loading and hauling stone and sand, including rehandling	.0812
Mixing and placing concrete	.1020
Watchman and miscellaneous labor	.0255
Cost of sand and stone f.o.b. DeKalb	.2280
Cost of cement f.o.b. DeKalb	.1700
Expansion joints (materials only)	.0218
Coal and oil for mixer and miscellaneous supplies	.0044
Forms and other lumber	.0163
Total	$0.8186

MALTA.

MALTA AND DE KALB ROAD, MALTA TOWNSHIP, DE KALB COUNTY.

The Malta and DeKalb road improvement began in the northern part of the village of Malta and extended west for a few hundred feet and east for a distance of nearly two miles, the total amount of road built being 10,800 feet. The country is somewhat rolling and a part of the road was constructed on a narrow embankment through some swampy land necessitating a considerable amount of earth work in order to get sufficient width for a roadway. On many sections of the road hills of considerable size were reduced so that the total amount of excavation on the road was considerably more than the average. Stone for the improvement was furnished from the penitentiary at Joliet and a part was shipped into Malta and hauled out along the road for storage until spring. The soil for the most part was a black loam, although on parts of the road it was a sandy loam.

The cost was paid from a special tax for hard road purposes and consisted in the construction of a waterbound macadam roadway 10 feet wide and 6 inches thick, which was bonded with a sandy loam obtained from a gravel pit near the village of Malta.

The following table is an itemized statement of the cost of this work:

Length of road	10,800 feet
Width of macadam	10 feet
Macadam laid	12,400 sq. yds.
Stone in road	4,082 cu. yds.
Stone hauled from cars	1,152 cu. yds.
Stone hauled from storage	2,932 cu. yds.
Aver haul of stone	¾ mile
Rate — [illegible]en, 22½-25 cents; teams, 50 cents per hour.	

COST OF LABOR AND SUPPLIES.

Superintendence	$ 390.00
Excavation	1,238.24
Shaping road bed	436.95
Loading stone	254.84
Hauling stone and gravel binder, including rehandling	2,825.25
Spreading stone	520.48
Trimming shoulders and side roads	328.59
Rolling and sprinkling	193.00
Watchman and miscellaneous labor	295.57
Coal, oil and supplies	195.26
Cost of gravel binder at pit	120.00
Freight on stone	2,538.71
Total	$9,336.89

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone on wagons	$0.0620
Hauling stone, including rehandling	.6920
Spreading stone	.1270
Rolling and sprinkling	.0473
Watchman and miscellaneous labor	.0724
Coal, oil and supplies	.0478
Total	$1.0485

COST PER SQUARE YARD FINISHED WATERBOUND MACADAM.

Superintendence	$0.0315
Excavation	.1000
Shaping road bed	.0350
Trimming shoulders and side roads	.0205
Placing stone	.3450
Freight on stone	.2100
Cost of bonding gravel at pit	.0097
Total	$0.7517

DeKalb.

SOUTH FIRST STREET ROAD, DE KALB TOWNSHIP, DE KALB COUNTY.

The South First street road was a well worn waterbound macadam, the surface of which was slightly rutted and somewhat uneven. The asphalt surfacing consisted in cleaning the existing surface and coating with about ¾ gallon per square yard of surface of an asphaltic compound. After the asphaltic compound was spread, the surface was covered with ¼-inch gravel and opened to traffic. The binder used was binder No. 298.

The following table is an itemized statement of the cost of this work:

Length of road	4,230 feet
Width of road	10 feet
Amount of macadam surfaced	4,700 sq. yds

Binder used	3,700 gallons
Length of haul	1 mile
Amount of binder used per square yard	0.78 gallon

Rate of pay: Men, 25 cents; teams, 45 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 35.00
Sweeping and cleaning surface	9.75
Loading, hauling and spreading gravel	67.75
Rolling	18.50
Heating, hauling and spreading binder	46.50
Watchman and miscellaneous labor	46.75
Cost of binder f.o.b. DeKalb	259.00
Cost of gravel	78.30
Coal, oil and supplies	17.00
Total	$578.55

COST PER SQUARE YARD FOR BITUMINOUS SURFACING.

Cost of bituminous binder	$0.0555
Cost of applying binder	.0099
Other labor and materials	.0577
Total	$0.1231

HINDSBORO.

HINDSBORO-OAKLAND ROAD, SARGENT TOWNSHIP, DOUGLAS COUNTY.

The Hindsboro-Oakland road improvement begins at the township line between Sargent and Bowdre townships on the road known as the Hindsboro-Oakland road, and extends in an easterly direction along this road for 15,800 feet.

For the most part, the country is only slightly rolling, and the road required no large amount of earth work, but at one section there was a bad ravine and two steep hills. The fill in this ravine was widened and raised, and the grades on the hills on either side were reduced to about 4 per cent.

Stone for the improvement was purchased for $1.05 per ton and delivered at Oakland or Hindsboro, from which places it was hauled. The haul for the material was an average of about three miles, and a traction engine hauling outfit was used for placing a part of the stone. The road was improved with a waterbound macadam 10 feet wide and 8 inches thick. The cost of the improvement was paid from a fund raised by a special tax.

The following table is an itemized statement of the cost of this work:

Length of road	16,800 feet
Width of macadam	10 feet
Macadam laid	18,666 sq. yds.
Stone in road	6,570 cu. yds.
Stone hauled from cars	6,570 cu. yds.
Average haul of stone	3 miles

Rate of pay: Men, 20 cents; teams, 40 cents per hour.

West Serena bridge, Serena Township, LaSalle County.

Two deck girder spans, each 45 feet long; roadway, 18 feet. Height of finished roadway above bottom of footings, 24½ feet. This structure is founded on rock. Built in 1912. Cost, $4,073.50. Miller-Hey Construction Company, Waterloo, Iowa, contractors. Where plenty of head room is available, deck girders may be used to advantage as less concrete is necessary in piers and substructure than is required for through girder bridges. Designed by the Illinois Highway Commission.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 372.00
Excavation	1,426.90
Shaping road bed	140.00
Loading and hauling stone	3,285.51
Spreading stone	454.40
Rolling and sprinkling	413.76
Watchman and miscellaneous labor	248.45
Coal, oil and supplies	267.11
Cost of stone	6,950.00
Total	$13,558.13

COST PER CUBIC YARD FOR PLACING STONE.

Loading and hauling stone	$0.500
Spreading stone	.069
Rolling and sprinkling	.063
Watchman and miscellaneous labor	.038
Coal, oil and supplies	.041
Total	$0.711

COST PER SQUARE YARD FINISHED WATERBOUND MACADAM.

Superintendence	$0.0199
Excavation	.0765
Placing stone	.2502
Freight on stone	.3724
Shaping road bed	.0075
Total	$0.7265

DATA ON COST OF HAULING WITH TRACTOR OUTFIT AT HINDSBORO.

AVERAGE LENGTH OF HAUL, THREE MILES.

Number of cubic yards of stone hauled by engine	2,590
Number of cubic yards of stone hauled by team	3,980
Number of days outfit was on job	120
Number of days outfit hauled (fractions counted as full)	40

COSTS.

Cost to Illinois Highway Commission of engine operator (salary and expenses, straight time)	$340.00
Cost of fireman (actual time worked)	66.20
Coal, oil and supplies for outfit	181.81
Cost of maintenance of hauling outfit (one-half season)	53.00
Total	$641.01
Total cost per cubic yard for hauling	$0.247
Total cost per cubic yard to township for hauling	.096
Total cost per cubic yard to State for hauling	.151
Actual cost per cubic yard for team hauling (on same work and same length haul)	.560
Cost of hauling by engine per cubic yard mile	.082
Cost of hauling by team per cubic yard mile	.186

DETAILED COSTS OF ENGINE HAULING PER CUBIC YARD MILE.

Operator	$0.043
Fireman	.008
Coal, oil, etc	.024
Maintenance	.007
Total	$0.082

WHEATON.

MILTON TOWNSHIP, DU PAGE COUNTY.

In 1908 and 1909 several sections of waterbound macadam were constructed in Milton township, DuPage County, under the general supervision of the Illinois Highway Commission, stone for which was furnished from the penitentiary at Joliet.

These roads were all subjected to a considerable amount of automobile traffic, and as a result the fine material surrounding the larger stone in the surface of the road have been swept out, leaving the road bare of fine material and rough. In 1912, it was decided to surface all of these roads with a bituminous compound. The roads were cleaned, all minor unevenness repaired, and coated with about ¾ gallon per square yard of surface of an asphaltic binder. The road was then covered with ¼-inch gravel and opened to traffic.

One section of 480 feet on the Batavia road was in a condition requiring more extensive treatment, and two applications of bituminous binder, amounting to a total of about 2 gallons per square yard of surface were used. The surface was dressed with gravel and in the same manner as for other roads. Binders No. 296 and No. 298 were used on this road.

The following table is an itemized statement of the cost of this work:

Amount of road repaired:		
Chicago road, 4,045-ft.x 12-ft	5,393	sq. yds.
Chicago road, 2,725-ft.x 10-ft	3,028	sq. yds.
Batavia road, 2,880-ft.x 9-ft	2,880	sq. yds.
Cemetery road, 2,310-ft.x 14-ft	3,593	sq. yds.
Total square yards treated	14,894	sq. yds.
Amount of binder used	10,650	gallons
Length of haul for gravel	2	miles

Rate of pay: Men, 30 cents; teams, 60 cents per hour.
(Batavia road had 480 feet of new work, had 2 gal. treatment.)
Amount of binder used per square yard of surface, 0.71.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 90.00
Sweeping and cleaning surface	18.00
Loading, hauling and spreading stone to repair holes	76.00
Loading, hauling and spreading gravel	199.45
Rolling	170.00
Heating, hauling and spreading binder	145.20
Watchman and miscellaneous labor	161.25

Cost of asphalt binder	$745.50
Cost of gravel and stone	201.42
Coal, oil and miscellaneous supplies	44.20
Total	$1,851.02

COST PER SQUARE YARD FOR SURFACING.

Bituminous binder	$0.0500
Applying bituminous binder	.0098
Other labor and materials	.0645
Total	$0.1245

EFFINGHAM.

SOUTH FOURTH STREET ROAD, DOUGLAS TOWNSHIP, EFFINGHAM COUNTY.

The South Fourth street road begins at the south end of the pavement on Fourth street in the city of Effingham and extends in a southerly direction for a distance of one mile. The soil is the typical white clay of southern Illinois, and the country is level.

The improvement consisted in the construction of one mile of water-bound macadam, 12 feet wide, together with the necessary earth work to insure drainage. The macadam was laid 8 inches thick and constructed of the stone furnished by the Southern Illinois Penitentiary. Part of the crushed stone was shipped in and unloaded early in the summer and the remainder hauled directly from the cars. The hauling was done by contract. Funds for the improvement were raised by a special tax for hard road purposes.

The following table is an itemized statement of the cost of this road:

Length of road	5,300 feet
Width of macadam	12 feet
Macadam laid	7,066 sq. yds.
Stone in road	2,400 cu. yds.
Stone hauled from cars	1,142 cu. yds.
Stone hauled from storage	1,258 cu. yds.
Average haul of stone	1 mile

Rate of pay: Men, 17½ cents; teams, 40 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 123.00
Excavation	146.45
Shaping road bed	94.25
Loading and hauling stone, including rehandling	697.00
Spreading stone	164.62
Trimming shoulders and side roads	102.20
Rolling and sprinkling	121.50
Watchman and miscellaneous labor	82.55
Coal, oil and supplies	49.37
Freight and car service	2,183.15
Contractor's profit on stone hauling	339.00
Total	$4,103.09

West Serena bridge, Serena Township, LaSalle County.

As this type of bridge is supported by concrete girders underneath the floor, the rails may be built in any manner desired to afford protection to the traffic and to lend to the finished structure the appearance desired.

COST PER CUBIC YARD FOR PLACING STONE.

Unloading stone from cars and hauling stone, including rehandling	$0.290
Spreading stone	.069
Rolling and sprinkling	.050
Watchman and miscellaneous labor	.034
Coal, oil and supplies	.021
Contractor's profit on stone hauling	.141
Total	$0.605

COST PER SQUARE YARD FINISHED MACADAM.

Superintendence	$0.0174
Excavation	.0207
Shaping road bed	.0130
Trimming shoulders and side roads	.0145
Placing stone	.2070
Freight on stone	.3100
Total	$0.5826

Gibson City.

CHURCH STREET ROAD, DRUMMER TOWNSHIP, FORD COUNTY.

Church street road begins at the L. E. & W. tracks on Church street in the city of Gibson, and extends in a northerly direction for a distance of about 5,000 feet, thence in a westerly direction for a distance of about 1,500 feet. The portion of the road which is on Church street was constructed 27 feet wide with concrete curb and gutters. A portion of the road extending west from the end of Church street was made 12 feet wide with earth shoulders.

The Church street road is a bituminous macadam, while that beyond Church street is waterbound macadam. The soil is a black sticky loam, and a considerable part of the street was poorly drained, making it difficult to secure a satisfactory foundation.

Stone for the improvement was furnished from the penitentiary at Joliet, and the improvement was paid from the funds raised by special assessment on the abutting property.

Two sizes of stone were used in the bituminous macadam construction as follows: Stone passing a 2½-inch ring and being retained on a ¾-inch ring known as 2½-inch stone; chips passing a ¾-inch ring, and gravel passing through a 1-inch ring and retained on a ¼-inch ring, and finer gravel ranging from ⅜ inch to ⅛ inch. The bituminous macadam was made 9 inches thick at the crown and 6 inches thick at the curb, the upper course being a uniform thickness of 2½ inches after being rolled. The lower course was made 6½ inches thick at the center and 3½ inches thick at the curb line. The lower course was rolled and bonded with screenings before the upper course was placed. The upper course was placed and rolled and the interstices partly filled with 1¼-inch gravel. The first spreading of the bituminous binder was then applied and the 1¼-inch gravel again spread and brushed into the remaining openings in the surface.

The second application of the bituminous binder was then spread and covered with the torpedo gravel. After the entire roadway had been completed, it was decided that the surface would be improved by a light paint coat throughout. The surface was therefore swept clean of detritus and two-fifths gallon of binder per square yard was applied and covered with the torpedo gravel. It should be noted that two sizes of coarse gravel were used in this construction, one ranging about 1¼ or 1½ inches down to ¼ inch, and another size ranging from 1 inch down to ¼ inch. The smaller of these two sizes was found to be much superior to the other for the bituminous construction, but it was impossible to obtain a sufficient supply of it for use throughout in the construction.

The bituminous binders used were as follows: beginning at the north side of Ninth street and extending north for 255 feet; two coats of binder No. 251, each coat using about 1¼ gallons, one coat of binder No. 251, amounting to about two-fifths gallon per square yard of surface.

On the section extending north for 30 feet from the above section, there was used as follows: for the first spreading 1¼ gallons per square yard of binder No. 251, followed by about an equal quantity of binder No. 243, and a seal coat consisting of two-fifths gallon per square yard of binder No. 251.

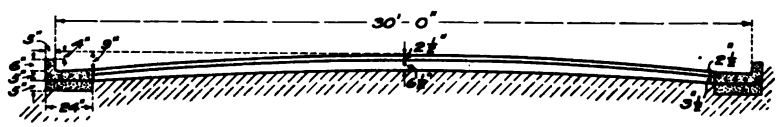


FIG. 8. Cross section of Church street road, Gibson City.

On the section extending north for 200 feet from the above section, the following treatment was used: first spreading of binder about 1¼ gallons of binder No. 243, followed by one gallon of No. 243, in turn followed by a seal coat of two-fifths gallon per square yard of binder No. 251.

The remainder of the road was surfaced with the following binders: the first spreading consisted of one gallon per square yard of surface of the binders used in the order given, Nos. 270, 241, 239, 240 and 171. The second application of bituminous binder was made up of two parts of one of the following binders, Nos. 270, 241, 239, 240 and 171; and one part of Nos. 193, 278 or 279. The seal coat consisted of about two-fifths gallon per square yard of surface of binder made up of eight parts of No. 278 or No. 279, and one part of binder No. 270.

The manner in which the work was carried out on account of weather conditions, made it practically impossible to keep the binders of a certain grade separated, so that binders of different grades were used as described above.

The following table is an itemized statement of the cost of this work:

Length of road	5,694 feet
Width of macadam: 5194 ft.-27 ft. wide; 500 ft.-12 ft. wide.	
Macadam laid	18,021 sq. yds.
Stone in road	6,433 cu. yds.
Stone hauled from cars	5,033 cu. yds.
Stone hauled from storage	1,400 cu. yds.
Average haul of stone	½ mile
Surface treated with bituminous binder	17,355 sq. yds.
Bituminous binder used	40,048 gallons
Rate of pay: Men, 20 cents; teams, 35 cents per hour.	

COST OF LABOR AND SUPPLIES.

Superintendence	$ 400.00
Excavation	223.20
Shaping road bed	260.40
Loading stone and gravel on wagons	686.65
Hauling stone, including rehandling	1,622.78
Spreading stone	603.75
Rolling and sprinkling	210.60
Watchman and miscellaneous labor	291.35
Coal, oil and supplies	310.70
Heating, hauling and spreading bituminous binder	420.38
Cost of bituminous binder delivered	4,004.00
Freight on stone	4,928.20
Cost of gravel for bituminous surface	648.12
Total	$14,610.13

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone and gravel	$0.105
Hauling stone, including rehandling	.253
Spreading stone	.094
Rolling and sprinkling	.034
Watchman and miscellaneous labor	.045
Coal, oil and supplies	.049
Total	$0.580
Cost per gallon for applying binder (heating, hauling and spreading)	$0.01

COST PER SQUARE YARD FINISHED WATERBOUND MACADAM.

Superintendence	$0.022
Excavation	.012
Shaping road bed	.014
Placing stone	.207
Freight on stone	.273
Total	$0.528

COST PER SQUARE YARD FINISHED BITUMINOUS MACADAM.

Superintendence	$0.0222
Excavation	.0124
Shaping road bed	.0140
Placing stone	.2070

A view of the forms and falsework for a double span, deck girder bridge. Abutments and pier completed. Girder and floor forms completed and rail forms nearing completion.

Applying bituminous binder	$0.0241
Cost of bituminous binder	.2300
Freight on stone	.2730
Gravel for bituminous surface	.0372
Total	$0.8197

SIBLEY.

SIBLEY-CROPSEY ROAD, SULLIVANT TOWNSHIP, FORD COUNTY.

The Sibley-Cropsey road improvement begins near the Wabash railroad track in the village of Sibley and extends in an easterly direction for a distance of 5,473 feet. The country is fairly level, but the nature of the road was such as to require a considerable amount of grading in order to secure proper surface drainage. The soil is a heavy black loam.

Three reinforced concrete culverts were constructed along the road, but the cost of these culverts is not included in the table of cost for the road, but is reported separately in the report on the bridge work. A part of the stone was shipped in and unloaded on the ground before work began, and the remainder was hauled from the cars. Stone was furnished from the penitentiary at Joliet, and bonding gravel was secured at Wirth, Illinois.

The improvement consists of a waterbound macadam 12 feet wide and 8 inches thick, surfaced with a bonding gravel. The funds for the work were derived in part from the township road tax and in part by subscription.

The following table is an itemized statement of the cost of this work:

Length of road	5,473 feet
Width of macadam	12 feet
Macadam laid	7,300 sq. yds.
Stone in road	2,392 cu. yds.
Stone hauled from cars	1,457 cu. yds.
Stone hauled from storage	935 cu. yds.
Average haul of stone	¾ mile

Rate of pay: Men, 25 cents; teams, 40 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 189.00
Excavation	804.45
Shaping road bed	165.10
Loading stone	381.95
Hauling stone, including rehandling	953.27
Spreading stone	226.90
Trimming shoulders and side roads	28.70
Rolling and sprinkling	150.00
Watchman and miscellaneous labor	26.25
Coal, oil and supplies	91.75
Cost of gravel binder delivered	122.95
Freight on stone	1,652.50
Total	$4,792.82

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone on wagons	$0.159
Hauling stone, including rehandling	.398
Spreading stone	.095
Rolling and sprinkling	.063
Watchman and miscellaneous labor	.011
Coal, oil and supplies	.033
Total	$0.759

COST PER SQUARE YARD FINISHED WATERBOUND MACADAM.

Superintendence	$0.0259
Excavation	.1100
Shaping road bed	.0225
Trimming shoulders and side roads	.0039
Placing stone	.2590
Freight on stone	.2260
Gravel binder	.0168
Total	$0.6551

SHAWNEETOWN.

FAIR GROUNDS ROAD, SHAWNEE TOWNSHIP, GALLATIN COUNTY.

The Fair Grounds road was improved from a point about one-fourth mile beyond the Gallatin County Fair grounds for a distance of 4,000 feet. It was intended to improve the road back to the corporate limits of the city of Shawneetown, but on account of lack of material and inability to get the same during the past fall, the work was discontinued when 4,000 feet of road had been constructed. The road was constructed of 6 inches of crushed stone surfaced with 2 inches of crushed gravel which was bonded with loam and screenings.

The road is level and no considerable amount of earth work was necessary to prepare it for the crushed stone.

Funds for the improvement were provided from a special hard road tax and the stone was furnished from the penitentiary at Menard, part of which was shipped in and unloaded before the construction work began. The gravel was Ohio River gravel which came from near Evansville, Indiana. Inasmuch as this work was not completed at the close of the season, and some work had been done prior to the arrival of the inspector furnished by the State Highway Commission, no itemized statement of the cost of this work is given.

As the commissioners in charge of the work near Shawneetown had been somewhat familiar with the methods of construction, the work done in 1912 was in part undertaken before an outfit and inspector of the State Highway Commission arrived. This accounts for the lack of as detailed cost data as are available on many other roads built under the supervision of the State Highway Commission.

Length of road finished	4,000 feet
Width of macadam	12 feet
Macadam laid	5,330 sq. yds.
Average haul of stone	1 mile

Rate of pay: Men, 15 cents; teams, 35 cents per hour.

SHAWNEETOWN.

SHAWNEETOWN-BOWLESVILLE ROAD, BOWLESVILLE TOWNSHIP, GALLATIN COUNTY.

This road is an extension of the South Main street road which was constructed in 1910, and extends across a levy which was placed by the commissioners during the season of 1911. The improvement consisted of a crushed stone macadam 12 feet wide and 8 inches thick. Stone for the improvement was furnished from the penitentiary at Menard and was shipped in and unloaded before construction work began.

Funds for the work were obtained from a special hard road tax.

The following table is an itemized statement of the amount of work done on this road, but no detailed statement of the cost is available:

Length of road	3,400 feet
Width of macadam	12 feet
Macadam laid	4,533 sq. yds.
Stone in road	1,314 cu. yds.
Stone hauled from cars	120 cu. yds.
Average haul of stone	1 mile
Grading	$1,150.00
Freight on stone	1,335.00
Labor and miscellaneous	1,489.42
Total	$3,974.42
Total cost per square yard	$0.877

SHAWNEETOWN.

NEW HAVENHILL ROAD, SHAWNEE TOWNSHIP, GALLATIN COUNTY.

This road begins at the Ohio River levy, northeast of the city of Shawneetown and extends in a northeasterly direction for a distance of 6,260 feet. During 1911, an embankment was placed across the bottom and lowlands for this road, and in 1912 the stone was placed on this embankment which had to be widened somewhat in order to accommodate the width of roadway desired.

The macadam was made 8 inches thick, of which 6 inches was crushed stone and 2 inches gravel. The crushed stone was placed and rolled and the gravel was then spread on top of the crushed stone and covered with loam and opened to traffic. The funds for this improvement were provided by means of a special hard road tax.

The following table shows the amount of work done on this road, but no itemized statement of the cost is available:

Length of road	6,260 feet
Width of macadam	12 feet
Macadam laid	8,347 sq. yds.
Stone in road, including gravel surface	2,500 cu. yds.
Average haul of stone	1½ miles

Rate of pay: Men, 15 cents; teams, 35 cents per hour.

820

P. O. Johns bridge, Road District No. 4, Massac County.

Through girder type, reinforced concrete bridge. Two 60-foot spans; 16-foot roadway. Piles were used to support the foundation of this structure. Completed in 1911. Total cost, $4,241.00. Gass Brothers, Belleville, Illinois, contractors. Designed by the Illinois Highway Commission.

WHITEHALL.

BRIDGEPORT STREET ROAD, WHITEHALL TOWNSHIP, GREENE COUNTY.

The Bridgeport road improvement begins on Bridgeport street in the city of Whitehall at the C. & A. railroad tracks and extends in a westerly direction on Bridgeport street and along the country road known as the Bridgeport street road for a distance of 9,500 feet. The country is somewhat rolling and a considerable amount of cutting and filling was done along the lines of the improvement. Twenty-five hundred feet of the road were made 16 feet wide and 8 inches thick at the middle and 6 inches thick at the edge. Seven thousand feet were made 12 feet wide and 8 inches thick throughout. A total of 13,778 square yards of macadam was placed on this road, of which 11,100 square yards were bituminous construction, and the remainder was waterbound.

Stone for the improvement was furnished from the penitentiary at Menard, and a large amount of it was shipped in and unloaded on the ground before construction began.

The construction of this road was started in August, 1911, and the construction was completed in the summer of 1912.

The portion of the road which was constructed in 1911 was surfaced with an asphalt, which when first applied, gave every indication of being entirely satisfactory. When cold weather came, it was apparent that the binder was too brittle, and the road surface broke up, and a considerable amount of it had to be resurfaced in 1912. The resurfacing was done with a different character of binder, which appears to be more satisfactory. The road was constructed in part from the township funds, and in part from funds paid by subscription.

A large amount of refuse from the Whitehall sewer tile works was used for the lower course on the road. The broken tile were placed and rolled, then covered with the upper layer of crushed stone, which was made one inch thicker than where the lower course was entirely of crushed stone.

A large amount of the stone hauling and grading was done by teams donated by the farmers interested in the improvement, and in the cost report of this road, these donation teams are included at the same rate per day as teams which were hired. As a matter of fact, this makes the apparent cost of the road somewhat greater than it really was, due to the fact that a great many donation teams were unable to work quite the full day, and for that reason were not on the same basis as the teams which were being paid, but the whole improvement was obtained with a comparatively small cash outlay.

Three sizes of crushed stone were used as follows: 2-inch, 3-inch and screenings. Two sizes of gravel were used in the bituminous surfacing as follows: Binder gravel, ranging in size from ¾-inch to ½-inch, and torpedo gravel ranging in size from ⅜-inch to ⅛-inch.

The lower course was made of 2-inch stone which was placed, rolled and bonded with screenings. The upper course was made of 3-inch stone which was spread and rolled.

The first spreading of bituminous binder was applied to this layer of stone and rolled once over. The surface was then covered lightly with the ¾-inch gravel which was swept into the voids. The second application of bituminous binder was then spread and covered with the torpedo gravel. On some sections of the road a third spreading of binder was made and covered with torpedo gravel.

Details of bituminous treatment.

Station 0-43—Surfaced in 1911 with two coats of binder No. 181. Resurfaced in 1912 with two coats of binder No. 272.

Station 43-56—Surfaced with three coats of fluxed binder made up of 75 per cent No. 272 and 25 per cent No. 178.

Station 56-62—Surfaced with three coats of fluxed binder made up of 66 per cent binder No. 272 and 34 per cent of binder No. 168.

Station 62-68—Surfaced with three coats of fluxed binder made up of 75 per cent binder No. 272 and 25 per cent binder No. 168.

Station 68-75—Surfaced with three coats of fluxed binder made up of 75 per cent binder No. 272 and 25 per cent binder No. 168.

Station 75 to end—Waterbound macadam.

The following table is an itemized statement of the cost of this road, the donation teams being included at the same rate as the pay teams:

Length of road	9,500 feet
Width of macadam: 2,500 ft.-16 ft. wide; 7,000 ft.-12 ft. wide.	
Macadam laid	13,778 sq. yds.
Stone in road	3,200 cu. yds.
Tile refuse in road	800 cu. yds.
Average haul of stone	1½ miles
Surface treated with bituminous binder	11,100 sq. yds.
Bituminous binder used	22,915 gallons
Rate of pay: Men, 17½-20 cents; teams, 32½ cents per hour; spreading binder, men, 25 cents per hour.	

COST OF LABOR AND SUPPLIES.

Superintendence	$ 860.00
Excavation	1,109.09
Shaping road bed	72.60
Loading stone and broken tile	532.03
Hauling stone, gravel and broken tile, including rehandling	1,763.97
Spreading stone	438.24
Trimming shoulders and side roads	101.13
Rolling and sprinkling	550.65
Watchman and miscellaneous labor	70.50
Coal, oil and supplies	109.10
Heating bituminous binder	174.78
Hauling and spreading bituminous binder	138.60
Cost of bituminous binder delivered	1,833.20
Freight on stone	2,517.30
Cost of gravel	165.63
Total	$10,436.82

COST FOR CUBIC YARD FOR PLACING STONE AND TILE REFUSE.

Loading stone and broken tile on cars	$0.133
Hauling stone, including rehandling	.441
Spreading stone	.109
Rolling and sprinkling	.138
Watchman and miscellaneous labor	.017
Coal, oil and supplies	.027
Total	$0.865

COST PER GALLON FOR APPLYING BINDER.

Heating, hauling and spreading	$0.0136
Amount of bituminous binder used per square yard surface	2.05 gallons

COST PER SQUARE YARD FINISHED WATERBOUND MACADAM.

Superintendence	$0.0622
Excavation	.0806
Shaping road bed	.0052
Trimming shoulders and side roads	.0073
Placing stone	.2520
Freight on stone	.1835
Total	$0.5898

COST PER SQUARE YARD FINISHED BITUMINOUS MACADAM.

Superintendence	$0.0622
Excavation	.0806
Shaping road bed	.0052
Trimming shoulders and side roads	.0073
Placing stone	.2520
Applying bituminous binder	.0282
Cost of bituminous binder	.1650
Freight on stone	.1825
Cost of gravel binder	.0149
Total	$0.7979

GENESEO.

CEMETERY ROAD, GENESEO TOWNSHIP, HENRY COUNTY.

The Cemetery road improvement begins at the north city limits of the city of Geneseo and extends in a northerly direction past the cemetery to the town. The country is somewhat rolling, but no considerable amount of earth work was necessary in preparing the road for the stone. The soil is partly a black sticky loam and partly sandy loam, particularly on the north end towards the canal.

Stone for the improvement was furnished from the penitentiary at Joliet, and a part was shipped in and unloaded in the summer before construction work began. The funds for the improvement were furnished in part by the township commissioners from the township road and bridge fund, and a part was raised by subscriptions by the citizens of the city of Geneseo.

Old timber bridge, to take the place of which the structure shown on Plate 36 was designed and built.

During 1912, 5,200 feet of road were constructed. There remains about 2,000 feet to build on this road, and it is desired to construct this early in the season of 1913.

The following table is an itemized statement of the cost of the work done in 1912:

Length of road	5,200 feet
Width of macadam	12 feet
Macadam laid	6,957 sq. yds.
Stone in road	2,500 cu. yds.
Average haul of stone	1 mile
Rate of pay: Men, 25 cents; teams, 45 cents per hour; spreading binder, 25 cents per hour.	

COST OF LABOR AND SUPPLIES.

Superintendence	$ 237.00
Shaping road bed	228.77
Loading stone	207.09
Hauling stone, including rehandling	1,195.47
Spreading stone	179.82
Trimming shoulders and side roads	128.72
Rolling and sprinkling	226.84
Watchman and miscellaneous labor	200.16
Coal, oil and supplies	125.65
Freight on stone	2,148.35
Cost of gravel binder delivered Geneseo	198.15
Total	$5,076.02

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone on wagons	$0.083
Hauling stone, including rehandling	.478
Spreading stone	.072
Rolling and sprinkling	.092
Watchman and miscellaneous labor	.081
Coal, oil and supplies	.051
Total	$0.857

COST PER SQUARE YARD FINISHED WATERBOUND MACADAM.

Superintendence	$0.0341
Shaping road bed	.0328
Trimming shoulders and side roads	.0185
Placing stone	.3070
Freight on stone	.3090
Cost of gravel binder	.0285
Total	$0.7299

WATSEKA.

WEST AND EAST SIDE ROADS, MIDDLEPORT TOWNSHIP, IROQUOIS COUNTY.

The commissioners of Middleport township began building several years ago macadam roads in two general directions from the city of Watseka.

One improvement extends in a general easterly and northerly direction from the city, and the other in a westerly and northerly direction from the city, and the work done during 1912 at Watseka was in extending these two roads, and a part of the work was done on each of the main roads leading out from the city. The soil is a sandy loam, and the roads were in comparatively level country requiring no great amount of excavation. A part of each of the roads was constructed on an embankment leading up to a bridge across the creek. The improvement consisted in the construction of 6,520 feet of waterbound macadam 10 feet wide.

Stone for the improvement was furnished from the penitentiary at Joliet and shipped in and unloaded before the construction work began. The work was paid from funds raised by a special tax for hard road purposes.

The following table is an itemized statement of the cost of this work:

Length of road	6,820 feet
Width of macadam	10 feet
Macadam laid	7,587 sq. yds.
Stone in road	2,175 cu. yds.
Stone hauled from cars	1,275 cu. yds.
Stone hauled from storage	900 cu. yds.
Average haul of stone	1½ miles

Rate of pay: Men, 20-22½ cents; teams, 40 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 235.40
Excavation	431.20
Shaping road bed	93.00
Loading stone	190.06
Hauling stone, including rehandling	1,169.07
Spreading stone	182.00
Trimming shoulders and side roads	64.20
Rolling and sprinkling	153.05
Watchman and miscellaneous labor	134.50
Coal, oil and supplies	56.80
Freight on stone	2,285.00
Cost of Kenneth screenings delivered	298.75
Total	$5,293.03

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone on wagons	$0.087
Hauling stone, including rehandling	.540
Spreading stone	.084
Rolling and sprinkling	.070
Watchman and miscellaneous labor	.062
Coal, oil and supplies	.026
Total	$0.869

COST PER SQUARE YARD FINISHED WATERBOUND MACADAM.

Superintendence	$0.031
Excavation	.057
Shaping road bed	.012
Trimming shoulders and side roads	.008
Placing stone	.248
Freight on stone	.303
Cost of bonding screenings	.039
Total	$0.697

CARBONDALE.

CARBONDALE-CARTERVILLE ROAD, CARBONDALE TOWNSHIP, JACKSON COUNTY.

The Carbondale-Carterville road improvement begins at the east city limits of the city of Carbondale, and extends in an easterly direction for about two miles. During the season of 1912, about one mile of this road was improved. The road was extended back into the city to the city pavement. The country is somewhat rolling, but a part of the road extends through a quicksand bottom which overflows during certain seasons of the year. No considerable amount of earth work was necessary in preparing the road for the stone. The stone for the improvement was furnished from the penitentiary at Menard, and part of the work was placed from the funds raised by a hard road bond issue. It is expected that this road will be extended during the season of 1913.

The following table is an itemized statement of the cost of the work done in 1912 on this road:

Length of road	5,100 feet
Width of macadam: 900 ft.-12 ft. wide; 4,200 ft.-14 ft. wide.	
Macadam laid	7,816 sq. yds.
Stone in road	3,020 cu. yds.
Stone hauled from cars	2,492 cu. yds.
Stone hauled from storage	528 cu. yds.
Average haul of stone	⅝ mile
Rate of pay: Men, 16⅔ cents; teams, 40 cents per hour.	

COST OF LABOR AND SUPPLIES.

Superintendence	$ 136.75
Excavation	345.77
Shaping roadbed	194.77
Loading stone	153.87
Hauling stone, including rehandling	798.70
Spreading stone	263.35
Trimming shoulders and side roads	46.97
Rolling and sprinkling	105.50
Watchman and miscellaneous labor	302.67
Coal, oil and supplies	113.70
Heating bituminous binder (sand used as binder)	88.86
Freight on stone	2,150.10
Total	$4,701.01

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone on wagons	$0.0509
Hauling stone, including rehandling	.2645
Spreading stone	.0872
Rolling and sprinkling	.0349
Watchman and miscellaneous labor	.1002
Coal, oil and supplies	.0376
Total	$0.5753

COST PER SQUARE YARD FINISHED WATERBOUND MACADAM.

Superintendence	$0.0175
Shaping road bed	.0249
Placing stone	.2225
Freight on stone	.2751
Cost of applying sand	.0114
Excavation	.0443
Trimming shoulders and side roads	.0059
Total	$0.6016

JERSEYVILLE.

FIELDON ROAD, JERSEY TOWNSHIP, JERSEY COUNTY.

Bituminous surfacing.

The Fieldon road was constructed as a waterbound macadam in 1909 and 1910. Service inspection reports were made on this road from time to time, and in the fall of 1911, it was decided that on account of the large amount of automobile traffic on this road, the surface should be covered with a bituminous compound in order to protect the surface and eliminate the dust. It was found that the automobile traffic was having the characteristic effect on this road of blowing away the finer particles of binder between the stone, leaving them somewhat open and causing deterioration of the road surface. The road had rutted in some sections, and other sections were considerably worn. The first operation was to repair the waterbound macadam surface by loosening with the scarifier and filling up the depressions until the surface had been restored. This work was done in the fall of 1911, but by the time it was completed, the weather was too cold for satisfactory bituminous surfacing and that work was postponed until the spring of 1912.

In the spring of 1912, the entire surface of the road was cleaned by sweeping until the stones were exposed and all the finer particles had been removed from the surface and around the stone, in so far as it was possible to do that with a sweeper. The entire surface was then painted with asphaltic binder No. 237 made up of 75 per cent of binder No. 234 or No. 228, and 25 per cent of binder No. 174, after which the surface was covered with coarse sand. Many sections of road after this treatment still had a somewhat uneven surface, and were given a second coating of the bituminous binder, followed by a covering of sand. In

this construction, about 0.6 of a gallon per square yard of surface of the asphaltic compound was used, and the binder was of such a nature that it "bled" considerably during hot weather.

The places where the binder exuded during hot weather were not covered on account of the neglect of the township commissioners, and the traffic pulled off some sections of the sticky surface. Later in the season all of these places were repaired and a section on the east end of the road which had rutted somewhat under traffic was put back in condition. Binder No. 317 was used in this repair work.

The following table is an itemized statement of the cost of this surface work:

Length of road surfaced	10,560	feet
Width of macadam surfaced	12	feet
Amount of macadam surfaced	14,080	sq. yds.
Amount of stone used	80	cu. yds.
Amount of sand used	60	cu. yds.
Amount of bituminous binder used	8,400	gallons

Rate of pay: Men, 20 cents; teams, 35 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$250.00
Reshaping old stone surface	56.75
Loading, hauling and spreading stone and sand	316.60
Rolling	146.90
Watchman and miscellaneous labor	181.60
Coal, oil and supplies	35.40
Heating bituminous binder, hauling and spreading bituminous binder	205.00
Cost of bituminous binder delivered	672.00
Cost of stone and sand delivered	125.06
Total	$1,989.31

COST PER SQUARE YARD FOR SURFACING.

Bituminous binder	$0.0477
Applying bituminous binder	.0146
Other labor and materials	.0790
Cost	$0.1413
Cost per gallon for applying binder (heating, hauling and spreading)	$0.0245

MOMENCE.

RANGE STREET ROAD, GANER-MOMENCE TOWNSHIPS, KANKAKEE COUNTY.

The Range street road is a village street on the township line between Ganer and Momence townships, and was a part of a system of voted roads for which the township furnished the money in accordance with special provisions of the hard road laws.

The improvement consisted in the construction of a bituminous macadam roadway of various widths along this main street of the village, the total length being about 5,000 feet. The street is com-

North Walnut street bridge, northwest of Springfield, Illinois, Springfield Township, Sangamon County.

A reinforced concrete bridge of the through girder type, consisting of three 45-foot spans; roadway, 20 feet. There are 124 piles under this structure, averaging 16 feet in length. Built in 1910. Cost, $7,901.50. C. A. Wever & Son, Clayton, Illinois, contractors. Designed by the Illinois Highway Commission.

paratively level and no considerable amount of excavation was done. On the two main blocks of the village, the macadam was made the full width of the street, 60 feet. On the other parts of the street, the widths were 20 feet and 16 feet. A part of the road was surfaced with a tar binder and a part with an asphaltic binder. Stone for the improvement was furnished from the penitentiary at Joliet, and the work was paid from funds obtained from a special hard road tax.

The work was done in the fall of 1911, and finished in the spring of 1912, and throughout was considerably interfered with by wet weather and irregular stone shipments.

Two and one-half-inch stone, ¾-inch chips and screenings were used. The stone on the road was placed in two courses, the lower course being 6 inches thick at the crown and 3 inches at the edge for all widths. The lower course was bonded with screenings. The upper course was made 3 inches thick and was rolled thoroughly before any binder was distributed. On some parts of the road chips were brushed into the voids in the surface before any binder was spread; on other parts the binder was spread before chips were put on. The first spreading of binder was covered lightly with clean chips which were brushed into the surface interstices, filling them flush with the surface of the stone. A second application of the bituminous binder was then spread and covered with sand. On a few sections of the road a third spreading of bituminous binder was made and covered with sand.

The bituminous binder was applied as follows:

From station 46 to 53+60, surfaced in 1911 with binder No. 177.

From station 50 to 53+60, redressed in 1912 with binder No. 263.

From station 50 to station 53+60, redressed in 1912 with binder No. 267.

From station 39 to 46, surfaced in 1911 with binder No. 176.

From station 46+60 to south end of bridge, redressed in 1912 with binder No. 263.

From station 33 to 39, surfaced in 1911 with binder No. 177; redressed in 1912 with binder No. 263.

From station 0 to 39, surfaced with a fluxed binder No. 267, made up of 75 per cent of binder Nos. 249, 229 or 230, and 25 per cent of binder No. 180.

From station 6+30 to 11, was sprinkled with a light road oil, after the bituminous surface had been completed and in use for a few days.

The following table is an itemized statement of the cost of the work:

Length of road	4,814 feet
Width of road: 1,962 ft.-16 ft. wide; 852 ft.-60 ft. wide; 2,000 ft.-20 ft. wide.	
Macadam laid, including intersections	13,612 sq. yds.
Stone in road	4,344 cu. yds.
Average haul of stone	½ mile
Surface treated with bituminous binder:	
Tar	2,800 sq. yds.
Asphalt	10,812 sq. yds.
Bituminous binder used:	
Tar	9,036 gallons
Asphalt	22,289 gallons
Rate of pay: Men, 20-25 cents; teams, 40 cents per hour.	

COST OF LABOR AND SUPPLIES.

Superintendence	$ 700.00
Excavation	395.35
Shaping roadbed	168.80
Loading stone on wagons	220.60
Hauling stone, including rehandling	1,142.40
Spreading stone	410.70
Trimming shoulders and side roads	50.00
Rolling and sprinkling	450.00
Watchman and miscellaneous labor	408.00
Coal, oil and supplies	202.31
Heating bituminous binder	157.50
Hauling and spreading bituminous binder	190.81
Cost of bituminous binder delivered	2,172.28
Freight on stone	1,500.75
Total	$8,170.50

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone on wagons	$0.052
Hauling stone, including rehandling	.263
Spreading stone	.094
Rolling and sprinkling	.103
Watchman and miscellaneous labor	.094
Coal, oil and supplies	.047
Total	$0.653

COST PER GALLON FOR APPLYING BINDER.

Heating, hauling, spreading	$0.011
Amount of binder per square yard of surface:	
Tar	3.2 gallons
Asphalt	2.1 gallons

COST PER SQUARE YARD FINISHED BITUMINOUS MACADAM.

Superintendence	$0.051
Excavation	.029
Shaping roadbed	.012
Trimming shoulders and side roads	.004
Placing stone	.208
Applying bituminous binder	.025
Cost of bituminous binder	.160
Freight on stone	.110
Total	$0.599

BRIDGEPORT.

SOUTH MAIN STREET ROAD, BRIDGEPORT TOWNSHIP, LAWRENCE COUNTY.

The South Main street road improvement begins at the south side of the B. & O. right-of-way on Main street in the village of Bridgeport, and extends in a southerly direction for a distance of 8,650 feet. The country is rolling and the road required considerable grading to fill the deep ditches which had washed alongside and to reduce some of the

steep grades. The soil is a very light colored clay. A large part of the stone for this improvement was shipped and unloaded in a storage pile during the spring preceding the construction of the road.

Two concrete bridges and two concrete culverts were constructed in connection with the improvement of this road, but the cost of these concrete bridges is not included in the table of cost given herewith, but is included in the report of the bridge work.

The funds for the improvement were raised by special tax and the work done under a no profit form of contract by the commissioners. The improvement consists of a waterbound macadam 12 feet wide, 8 inches thick, together with the bridges before mentioned.

The following table is an itemized statement of the cost of this work:

Length of road	8,650 feet
Width of macadam	12 feet
Macadam laid	11,533 sq. yds.
Stone in road	4,075 cu. yds.
Stone hauled from storage	3,660 cu. yds.
Stone hauled from cars	415 cu. yds.
Average haul of stone	1½ miles

Rate of pay: Men, 25 cents; teams, 50 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 421.00
Excavation	1,478.25
Shaping road bed	508.75
Loading stone	787.00
Hauling stone, including rehandling	3,728.50
Spreading stone	464.00
Trimming shoulders and side roads	459.50
Rolling and sprinkling	320.00
Watchman and miscellaneous labor	348.00
Coal, oil and supplies	101.13
Freight on stone	4,235.26
Total	$12,851.39

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone on wagons	$0.193
Hauling stone, including rehandling	.914
Spreading stone	.114
Rolling and sprinkling	.078
Watchman and miscellaneous labor	.085
Coal, oil and supplies	.025
Total	$1.409

COST PER SQUARE YARD FINISHED WATERBOUND MACADAM.

Superintendence	$0.0365
Excavation	.1280
Shaping road bed	.0440
Trimming shoulders and side roads	.0398
Placing stone	.4980
Freight on stone	.3670
Total	$1.1133

FAIRBURY.

EAST AND WEST SIDE ROADS, INDIAN GROVE TOWNSHIP, LIVINGSTON COUNTY.

The work at Fairbury was mostly within the corporate limits of the city, the road being constructed for the purpose of connecting some township hard roads to the city pavement. During 1912, a total of 4,100 feet of macadam 16 feet wide was completed. There remains about 1,000 feet of road to construct, which will not be taken up until 1913. The work done on the city streets followed very closely the existing grades and only a small amount of earth work was necessary in order to prepare the roadway for the crushed stone. The road was constructed as a waterbound macadam 16 feet wide and 8 inches thick.

Stone for the improvement was furnished from the penitentiary at Joliet. The cost of the work was paid from a fund raised in part by the city of Fairbury and in part by subscriptions. The soil is a black sticky loam, but the roadways were thoroughly well drained. All the work reported was completed during 1912, and opened for traffic, but on account of the lateness of the season when the finishing was done a small amount of redressing may be necessary in 1913.

The following table is an itemized statement of the cost of the work done on this road in 1912:

Length of road	4,410 feet
Width of macadam	16 feet
Macadam laid, including intersections	8,080 sq. yds.
Stone in road	2,826 cu. yds.
Stone hauled from cars	2,826 cu. yds.
Average haul of stone	¼ mile

Rate of pay: Men, 22½ cents; teams, 45-50 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 356.00
Excavation	686.74
Shaping road bed	148.12
Loading stone	226.16
Hauling stone, including rehandling	582.28
Spreading stone	162.40
Trimming shoulders and side roads	38.69
Rolling and sprinkling	173.15
Watchmen and miscellaneous labor	117.32
Coal, oil and supplies	82.82
Freight on stone, including cost of stone purchased	2,482.08
Total	$5,055.76

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone on wagons	$0.080
Hauling stone, including rehandling	.206
Spreading stone	.057
Rolling and sprinkling	.061
Watchman and miscellaneous labor	.042
Coal, oil and supplies	.029
Total	$0.475

COST PER SQUARE YARD FINISHED WATERBOUND MACADAM.

Superintendence	$0.0441
Excavation	.0851
Shaping roadbed	.0183
Trimming shoulders and side roads	.0048
Placing stone	.1663
Freight on stone, including cost of stone purchased	.3071
Total	$0.6257

LINCOLN.

SECTION 2 OF THE LINCOLN ROAD, EAST LINCOLN TOWNSHIP, LOGAN COUNTY.

In 1907 a waterbound macadam road was constructed in East Lincoln Township, beginning near the city limits of Lincoln and extending in a general easterly direction for a distance of about two miles. In 1912 it was decided to connect this section of waterbound macadam with the city pavement, and a total of 2,775 feet of waterbound macadam 20 feet wide was placed.

The lower course of the macadam was made of shale from a refuse pile at a coal mine near the road. The shale was placed in a layer 6 inches thick and thoroughly rolled. On top of this layer of shale there was placed a layer of 5 inches loose of crushed stone, which was thoroughly rolled, bonded with screenings and water and finally surfaced with a good grade of bonding gravel. The soil is a black sticky loam and the road was comparatively level, requiring only a small amount of earth work in order to prepare it for the stone.

Funds for the improvement were provided jointly by the city and citizens interested in the improvement.

The following table is an itemized statement of the cost of the work:

Length of road	2,775 feet
Width of macadam	20 feet
Macadam laid	6,166 sq. yds.
Stone in road, including bonding gravel	1,236 cu. yds.
Stone hauled from cars	1,036 cu. yds.
Stone hauled from storage	200 cu. yds.
Average haul of stone	¾ mile
Shale used for lower course	1,027 cu. yds.

Rate of pay: Men, 22½ cents; teams, 50 cents per hour. Spreading binder, men, 25 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$174.00
Excavation	127.20
Shaping road bed	107.02
Hauling and loading stone and gravel, including rehandling	809.52
Spreading stone and shale	190.38
Trimming shoulders and side roads	38.50
Rolling and sprinkling	70.25
Watchman and miscellaneous labor	59.54

Woodland bridge, Belmont Township, Iroquois County.

A reinforced concrete bridge, through girder type, consisting of three spans of 50 feet each; roadway, 18 feet. Piles were used to support the foundations of this structure. Built in 1911. Cost, $9,846.84. Jos. Klein, Freeburg, Illinois, contractor. Designed by the Illinois Highway Commission.

Coal, oil and supplies	46.38
Freight on stone and cost of stone purchased	974.25
Cost of gravel binder delivered	100.50
Total	$2,697.54

COST PER CUBIC YARD FOR PLACING STONE AND SHALE.

Loading stone and shale on wagons, hauling stone and shale including rehandling	$0.357
Spreading stone and shale	.085
Rolling and sprinkling	.031
Watchman and miscellaneous labor	.026
Coal, oil and supplies	.021
Total	$0.520

COST PER SQUARE YARD FINISHED WATERBOUND MACADAM.

Superintendence	$0.028
Excavation	.026
Shaping road bed	.017
Trimming shoulders and side roads	.006
Placing stone and shale	.191
Freight on stone and cost of stone purchased	.153
Gravel binder	.016
Total	$0.437

BLOOMINGTON.

SOUTH MORRIS AVENUE ROAD, BLOOMINGTON TOWNSHIP, MC LEAN COUNTY.

The South Morris avenue road improvement begins at the south end of the pavement on Morris avenue in the city of Bloomington, and extends southward along the South Morris avenue road to the place known locally as Six Points. The road then continues along the Bloomington-Springfield road in a southerly direction, the total length constructed being 14,000 feet.

The improvement consists of a bituminous macadam roadway 12 feet wide and 8 inches thick. Stone for the work was furnished from the

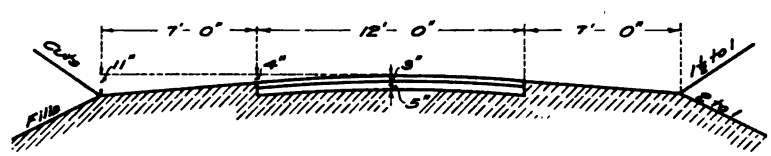


FIG. 9. Cross section of South Morris avenue road, Bloomington.

penitentiary at Joliet. The cost of the work was paid in part by the commissioners of Bloomington township, and in part from a fund raised by subscriptions.

In the construction of the bituminous macadam the lower course was made 5 inches thick and bonded with limestone screenings. The

upper course was made 3 inches thick, surfaced with a bituminous binder. In the construction of the bituminous surface, two sizes of gravel were used, one size ranging from 1-inch to ¼-inch being used before and after the first application of bituminous binders; the other size ranging from ¼-inch down being used after the second and third applications of bituminous binder.

A section of this road from Six Points southward for a distance of about 1¼ miles was completed in 1911, and in the construction of this section of road limestone screenings were used instead of gravel in the bituminous surface. This section of road went to pieces very rapidly when opened to traffic, and within a month or two was in an unsatisfactory condition. When the remainder of the road was completed in 1912 this section of road was resurfaced, a different class of bituminous binder being used, and the surface being dressed with gravel instead of screenings.

The distribution of the various binders used on this work is as follows:

Station 0 to 3+50—Two coats binder No. 167, limestone chips used for dressing.

Station 3+50 to 12—Two coats binder No. 167, gravel dressing used.

Station 12 to 18+50—Two coats binder No. 167, one coat binder No. 280, gravel dressing used.

Station 18+50 to 22—Two coats binder No. 167, one light coat binder No. 268 with gravel. Binder No. 268 is made of one part binder No. 242 and three parts No. 182, gravel dressing used.

Station 22 to 28—Two coats binder No. 167, one coat binder No. 268, one light coat binder No. 280, gravel dressing used.

Station 28 to 30—One coat binder No. 167, one coat binder No. 268, one light coat binder No. 280, gravel dressing used.

Station 30 to 40—Two coats binder No. 268, one light coat binder made of three parts No. 280 and one part binder No. 182, gravel dressing used.

Station 40 to 45—Two coats binder No. 167 applied fall of 1911. One coat of binder made of three parts No. 280 and one part of No. 182, applied 1912, gravel dressing used.

Station 45 to 53—Two coats binder No. 151, applied August, 1911. August, 1912, two coats binder No. 268 followed by one light coat made of one part binder No. 182 and three parts binder No. 280. Limestone chips used.

Station 53 to 60—Two coats binder No. 151 applied August, 1911. July, 1912, one light coat made of one part binder No. 182 and three parts binder No. 280, gravel dressing used.

Station 60 to 62+50—Two coats binder No. 151, applied 1911. 1912, three coats being made of one part binder No. 182 and three parts binder No. 280, gravel dressing used.

Station 62+50 to 67—Two coats binder No. 151 applied 1911. 1912, one light coat made of one part binder No. 182 and three parts binder No. 280, gravel dressing used.

Station 67 to 70+50—Two coats binder No. 151 applied 1911. 1912, one coat of binder made of one part binder No. 182 and three parts No. 280, gravel dressing used.

Station 70+50 to 72—Two coats binder No. 152 applied 1911. 1912, two coats binder No. 268 and one light coat made of one part binder No. 182, and three parts binder No. 280, gravel dressing used.

Station 72 to 83—Two coats binder No. 152 applied 1911. 1912, one coat of binder made of one part No. 182 and three parts No. 280, gravel dressing used.

Station 83 to 99—Two coats binder No. 152 applied 1911. 1912, one coat binder No. 280, gravel dressing used.

Station 99 to 106—Two coats binder No. 268, gravel dressing used.

Station 106 to 116-50—Two coats binder No. 268 and one coat made of one part No. 182 and three parts No. 280, gravel dressing used.

Station 116-50 to 130—One coat binder No. 268, two coats made of one part No. 182 and three parts No. 280, gravel dressing used.

Station 130 to 140—One coat binder No. 268, one coat made of one part No. 182 and three parts No. 280, and one coat binder No. 280, gravel dressing used.

The following table is an itemized statement of the cost of this work:

Length of road	14,000	feet
Width of macadam	12	feet
Macadam laid	18,667	sq. yds.
Stone and gravel in road	7,093	cu. yds.
Average haul of stone	1½	miles
Surface treated with bituminous binder	18,667	sq. yds.
Bituminous binder used	42,000	gallons
Rate of pay: Men, 22 cents; teams, 50 cents per hour.		
Amount of bituminous binder per square yard of surface	2.25	gallons

COST OF LABOR AND SUPPLIES.

Superintendence	$ 900.00
Excavation	880.81
Shaping road bed	661.97
Loading stone	791.78
Hauling stone and gravel, including rehandling	3,706.24
Spreading stone	768.31
Trimming shoulders and side roads	318.63
Rolling and sprinkling	431.74
Watchman and miscellaneous labor	985.62
Coal, oil and supplies	192.62
Heating bituminous binder, including fuel	192.04
Hauling and spreading bituminous binder	269.07
Cost of bituminous binder delivered	3,360.00
Freight on stone	3,174.00
Gravel dressing, f. o. b., Bloomington	292.51
Total	$16,925.34

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone on wagons	$0.111
Hauling stone, including rehandling	.522
Spreading stone	.108

Rolling and sprinkling	.066
Watchman and miscellaneous labor	.139
Coal, oil and supplies	.027
Total	$0.973
Cost per gallon for applying binder (heating, hauling and spreading)	$0.0109

COST PER SQUARE YARD FINISHED BITUMINOUS MACADAM.

Superintendence	$0.0484
Excavation	.0474
Shaping road bed	.0354
Trimming shoulders and side roads	.0171
Placing stone	.3670
Applying bituminous binder	.0247
Cost of bituminous binder	.1800
Freight on stone	.1700
Cost of gravel for bituminous surface	.0157
Total	$0.9057

SHIRLEY.

BLOOMINGTON-SPRINGFIELD ROAD, DALE TOWNSHIP, MC LEAN COUNTY.

The Bloomington-Springfield road improvement in Dale Township begins about one mile south of the south end of the Morris avenue road, which has previously been described, and extends southward along the Bloomington-Springfield road for a distance approximately 1¾ miles. The road was constructed as a waterbound macadam 12 feet wide and 8 inches thick. Stone for the improvement was furnished from the penitentiary at Joliet and the cost of the construction was paid from a fund raised by subscription.

During 1912, all of the stone was placed on this road, and a portion of it was finished with screenings and gravel. The remainder of the road was unfinished at the close of the season, and will be completed in the spring of 1913. The cost of the work will not be reported until a complete report is available when the road is finished.

MCLEAN.

TOWN SQUARE, MT. HOPE TOWNSHIP, MC LEAN COUNTY.

In 1907 a macadam road was constructed in the village of McLean extending from the town limits up to the town square, the town square itself not being improved. This town square consists of a triangular park surrounded by a roadway, along which are the principal business houses of the village. The improvement consists of a concrete roadway 45 feet wide with a total area of 5,000 square yards. The concrete was made 6 inches thick and was constructed from gravel to which was added a small amount of Joliet crushed stone.

The cost of the improvement was paid from funds raised by subscription among the business men of the village, and farmers living near.

In addition to the cost of the pavement which is given in the following table, a curb was constructed entirely around the park, the cost of which is not included herewith.

The following table is an itemized statement of the cost of this work:

Amount of pavement laid	5,000 sq. yds.
Thickness of pavement	6 inches
Width of pavement	45 feet
Length of haul for materials	⅛ mile
Cost of cement per bbl.	$1.02 and $1.06
Amount of cement used per square yard of pavement	0.29 bbl.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 140.00
Shaping road bed	307.41
Loading and hauling sand and stone, including rehandling	267.34
Mixing and placing concrete	414.63
Watchman and miscellaneous labor	110.26
Cost of sand and stone f.o.b. McLean	1,017.63
Cost of cement f.o.b. McLean	1,547.15
Expansion joints	48.67
Coal and oil for mixer and miscellaneous supplies	30.75
Forms and other lumber	35.00
Filling expansion joints next curbs	45.18
Total	$3,964.02

COST PER SQUARE YARD FOR LABOR AND SUPPLIES.

Superintendence	$0.028
Shaping road bed	.061
Loading and hauling stone and sand, including rehandling	.053
Mixing and placing concrete	.083
Watchman and miscellaneous labor	.022
Cost of sand and stone	.204
Cost of cement	.309
Expansion joints	.010
Coal and oil for mixer, and miscellaneous supplies	.006
Forms and other lumber	.007
Filling expansion joints next curbs	.010
Total	$0.793

CARLINVILLE.

BURKE LANE ROAD, CARLINVILLE TOWNSHIP, MACOUPIN COUNTY.

The Burke Lane improvement begins at the western edge of the C. & A. right-of-way in Carlinville and extends along what is known as Burke's Lane for a distance of 3,000 feet. The soil is a black loam, and the road was fairly level, but was thickly shaded and had been one of the worst roads in the community on that account. It had been filled in places with stone, brick and cinders, making what little excavation had to be done, expensive. The improvement consists of a concrete

roadway 16 feet wide and 6½ inches thick. Crushed stone for the concrete was furnished from the Southern Illinois Penitentiary and sand was hauled from a creek west of Carlinville.

The expense of the work was paid from a special fund raised by subscription by a committee of citizens representing property along the road.

From the C. & A. tracks to the culvert at about station 8, the middle of the road was reinforced by ½-inch square twisted bars 6 feet long, running crosswise and placed one foot from center to center. This was made necessary by a newly filled sewer trench under this section of road.

The following table is an itemized statement of the cost of this road:

Amount of pavement laid	7,111 sq. yds.
Thickness of pavement	6½ inches
Width of pavement	16 feet
Length of haul for materials:	
Sand	1½ miles
Stone	1½ miles
Cost of cement per bbl. f.o.b. Carlinville	98 cents
Amount of cement used per square yard of pavement	0.33 bbl.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 157.50
Excavation	591.73
Shaping road bed	108.70
Loading and hauling sand and stone, including rehandling	795.05
Mixing and placing concrete	700.58
Watchman and miscellaneous labor	131.46
Cost of sand and stone f.o.b. (stone freight only, sand free)	741.00
Cost of cement f.o.b. Carlinville	2,307.90
Expansion joints	112.40
Reinforcing steel	100.00
Coal and oil for mixer, and miscellaneous supplies	25.00
Forms and other lumber	31.75
Total	$5,803.07

COST PER SQUARE YARD FOR LABOR AND SUPPLIES.

Superintendence	$0.0220
Excavation	.0840
Shaping road bed	.0153
Loading and hauling stone and sand, including rehandling	.1120
Mixing and placing concrete	.0986
Watchman and miscellaneous labor	.0184
Cost of sand and stone f.o.b. (sand free at pit)	.1050
Cost of cement f.o.b. Carlinville	.3246
Expansion joints	.0156
Reinforcing steel	.0140
Coal and oil for mixer and miscellaneous supplies	.0034
Forms and other lumber	.0047
Total	$0.8176

COLLINSVILLE.

SECTION 2, COLLINSVILLE-EAST ST. LOUIS ROAD, COLLINSVILLE TOWNSHIP, MADISON COUNTY.

Section two of the Collinsville-East St. Louis road is a continuation of the road constructed in Collinsville township in 1910, the work beginning at the west end of the section previously constructed and extending westward for a distance of about 7/8 mile. The road runs through a part of the township which is covered with overflow water each spring, and it was necessary to grade the road above average high water level. Fig. No. 10 is a cross section showing the macadam and embankment.

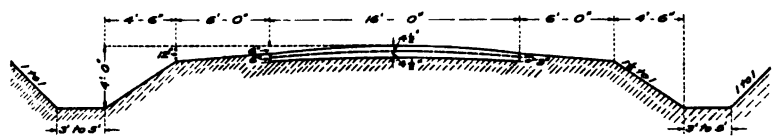


FIG. 10. Cross section of section 2 of the Collinsville-East St. Louis road.

The road is waterbound macadam 16 feet wide and 9 inches thick at the middle and 6 inches thick at the edge. Stone was furnished from the penitentiary at Menard. Work on the road was begun in the fall of 1911 and about 700 square yards of the road was finished and the remainder was completed in 1912.

The cost of the work, including grading, was about $8,000.00.

COLLINSVILLE.

SECTION 2 OF COLLINSVILLE-TROY ROAD, COLLINSVILLE TOWNSHIP, MADISON COUNTY.

The first section of the Collinsville-Troy road was constructed in the season of 1909. Section 2 was constructed in the season of 1912 as a continuation of the previous work and extends from the end of this work eastward on the Troy road for a distance of 4,900 feet, and west from the west end of the old macadam for a distance of 850 feet. At the east end, the macadam is 8 inches thick and 14 feet wide. At the west end of the old road, the macadam was placed 12 feet wide on each side of the interurban car tracks, which at this place are in the middle of the road.

Stone for the improvement was furnished from the penitentiary at Menard and a part was shipped and unloaded before the construction work began. The soil is a light clay, and a considerable amount of earth work was necessary to prepare the road for the stone. The funds for the work were provided by means of a special hard road tax.

The following table is an itemized statement of the cost of this work:

Length of road	**5,600 feet**
Width of macadam	**12 and 14 feet**
Macadam laid	**8,337 sq. yds.**

Sulphur Springs Bridge, Maine Township, Grundy County.

A reinforced concrete bridge, through girder type, consisting of three 50-foot spans; roadway, 16 feet. Piers and abutments founded on rock. Built in 1911. Cost, $5,919.64. W. H. Shons, Freeport, Illinois, contractor. Designed by the Illinois Highway Commission.

Stone in road	3,582 cu. yds.
Stone hauled from cars	3,000 cu. yds.
Stone hauled from storage	582 cu. yds.
Average haul of stone	1 mile

Rate of pay: Men, 22½ cents; teams, 50 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 306.50
Excavation	685.80
Shaping road bed	292.18
Loading and hauling stone, including rehandling	1,179.12
Spreading stone	422.88
Trimming shoulders and side roads	185.03
Rolling and sprinkling	256.62
Watchman and miscellaneous labor	235.11
Coal, oil and supplies	34.92
Freight and car service on stone	2,176.02
Total	$5,774.18

COST PER CUBIC YARD FOR PLACING STONE.

Loading and hauling stone, including rehandling	$0.329
Spreading stone	.118
Rolling and sprinkling	.072
Watchman and miscellaneous labor	.065
Coal, oil and supplies	.010
Total	$0.594

COST PER SQUARE YARD FINISHED WATERBOUND MACADAM.

Superintendence	$0.0368
Excavation	.0824
Shaping road bed	.0344
Trimming shoulders and side roads	.0222
Placing stone	.2555
Freight on stone	.2600
Total	$0.6913

HIGHLAND.

SECTION 2 OF THE TRENTON ROAD, HELVETIA TOWNSHIP, MADISON COUNTY.

This improvement began at the south end of the macadam which had already been constructed on the Trenton road and extended in a southerly and easterly direction for a distance of 8,400 feet. The country is comparatively flat, and the only earth work necessary was that which was done to raise the general grade of the road somewhat by drawing earth from the ditches.

The entire job was done by contract under the supervision and inspection of an engineer from the Illinois Highway Commission. The contract price for the construction was 98½ cents per square yard.

The road was constructed of a bituminous macadam 12 feet wide and 8 inches thick. The stone was placed in two layers, the lower layer being 5 inches in thickness and bonded with screenings. The upper layer being 3 inches thick and filled with two gallons per square yard of bituminous binder and covered with gravel. For the most part, the stone used was furnished from Green Castle, Indiana, although a small amount of local stone was crushed and used on parts of the road. The road was surfaced with two applications of bituminous binder No. 286, the first application being placed on the stone after it had been rolled. This application of binder was then covered with screened limestone chips which were brushed into the surface voids and again covered with about one gallon per square yard of bituminous compound. The surface was then covered with coarse sand and rolled and opened to traffic. The binder used was a fluxed binder made of 75 per cent of binder No. 246 and 25 per cent of binder No. 262.

The work was done by contract and no force account was kept.

TROY.

THE TROY-COLLINSVILLE ROAD, JARVIS TOWNSHIP, MADISON COUNTY.

The Troy-Collinsville road begins at the westerly city limits of the village of Troy and extends along what is known as the Old National road for a distance of one mile in a westerly direction. The country is fairly level and a comparatively small amount of earth work was done. The soil is a light colored clay.

Two or three culverts were constructed along the line of the improvement, but their cost is not included with the cost of the road.

The stone for the improvement was furnished from the Southern Illinois Penitentiary and a part was shipped and unloaded before the road work began. On account of adverse weather conditions, making it impossible to use a roller to advantage, the stone was placed and the road opened to traffic for some time before the roller was used to finish the surface. Funds for the improvement were provided by a special hard road tax and the work was done under a no profit form of contract.

The following table is an itemized statement of the cost of the work:

Length of road	5,280 feet
Width of macadam	12 feet
Macadam laid	7,040 sq. yds.
Stone in road	2,468 cu. yds.
Stone hauled from cars	2,000 cu. yds.
Stone hauled from storage	468 cu. yds.
Average haul of stone	1¼ miles

Rate of pay: Men, 19 cents; teams, 40 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 197.50
Excavation	198.25
Shaping road bed	135.00
Loading and hauling stone, including rehandling	739.58
Spreading stone	188.11

Trimming shoulders and side roads	179.70
Rolling and sprinkling	99.50
Watchman and miscellaneous labor	124.75
Coal, oil and supplies	56.40
Freight and car service on stone	2,423.53
Total	$4,342.32

COST PER CUBIC YARD FOR PLACING STONE.

Unloading stone from cars, hauling stone, including rehandling...	$0.3000
Spreading stone	.0770
Rolling and sprinkling	.0403
Watchman and miscellaneous labor	.0503
Coal, oil and supplies	.0227
Total	$0.4903

COST PER SQUARE YARD FINISHED WATERBOUND MACADAM.

Superintendence	$0.028
Excavation	.028
Shaping road bed	.019
Trimming shoulders and side roads	.025
Placing stone	.171
Freight on stone	.345
Total	$0.616

SPRINGFIELD.

PEORIA ROAD, SPRINGFIELD TOWNSHIP, SANGAMON COUNTY.

The Peoria road improvement begins at the southeasterly corner of the State Fair grounds and extends in a northerly direction along what is commonly called the Peoria road, for a distance of about two miles. The soil at the north end is black loam, and farther along clay and sandy soils are encountered. The road leads through rolling country, and a considerable amount of excavation was found to be desirable.

The construction work began during the fall of 1912, and about one-half mile of pavement was laid. It is expected that the work will be continued in the spring of 1913 until two miles of road have been completed. The roadway is gravel concrete 18 feet wide, 8 inches thick at the middle and 6 inches thick at the edge. On the section completed, armored expansion joints were used, but on the section to be built in 1913, it is planned to use creosoted block expansion and plain expansion joints filled with asphalt pitch.

The following table of costs applies to the work which was completed in the fall of 1912. A considerable amount of material was on hand at the close of the season, and will be carried over and used in 1913. Work on this road was begun shortly before the opening of the State Fair, and was considerably delayed on account of congestion at the switch tracks during the fair:

Amount of pavement laid	5,594 sq. yds.
Thickness of pavement	7 inches
Width of pavement	18 feet

Length of haul for materials	⅛ mile
Cost of cement per bbl.	$1.02½
Amount of cement used per square yard of pavement.	0.29

COST OF LABOR AND SUPPLIES.

Superintendence	$ 202.00
Shaping road bed	232.44
Trimming shoulders and side roads	211.38
Loading and hauling sand and stone, including rehandling	603.50
Mixing and placing concrete	644.25
Watchman and miscellaneous labor	383.75
Cost of sand and stone f.o.b. Springfield	1,622.01
Cost of cement f.o.b. Springfield	1,551.17
Expansion joints	206.74
Coal and oil for mixer and miscellaneous supplies	119.19
Forms and other lumber	18.33
Total	$5,794.76

COST PER SQUARE YARD FOR LABOR AND SUPPLIES.

Superintendence	$0.0361
Shaping road bed	.0415
Trimming shoulders and side roads	.0378
Loading and hauling sand and stone, including rehandling	.1078
Mixing and placing concrete	.1150
Watchman and miscellaneous labor	.0686
Cost of sand and stone	.2897
Cost of cement	.2772
Expansion joints	.0369
Coal and oil for mixer and miscellaneous supplies	.0213
Forms and other lumber	.0033
Total	$1.0352

PEKIN.

CEMETERY ROAD, PEKIN TOWNSHIP, TAZEWELL COUNTY.

The Cemetery road improvement begins in the northwest part of the city of Pekin at Willow street and extends along what is known as the Cemetery road for a distance of 5,800 feet. The soil is a sandy loam, and the road required comparatively little draining in order to make a satisfactory improvement. The improvement consisted in the construction of a bituminous macadam roadway 16 feet wide, except for about 500 feet at the north end, which was constructed of waterbound macadam bonded with screenings and loam.

The stone for this improvement was furnished from the penitentiary at Joliet and part was shipped and unloaded before construction work began and the remainder was hauled from the cars. All of the stone was hauled by contract. In the construction of the bituminous surface, the following plan was followed: The crushed stone for the road was placed in two layers, to give a total thickness of 7 inches at the crown and 6 inches at the edge of the macadam, the upper layer of stone being of uniform thickness of 2½ inches after rolling. The lower

course was placed and bonded with screenings, the upper course was placed and rolled and partially filled with limestone chips spread into the interstices. The surface was then covered with bituminous binder followed by a spreading of limestone chips which were swept into the interstices. The surface was again covered with a bituminous compound and dressed with coarse sand. A portion of the road from station 0 to 40 was surfaced with binder No. 275, and the portion of the road from station 40 to 50 was surfaced with binder No. 277. A third section from station 50 to 55 was surfaced with binder No. 231.

The following table is an itemized statement of the cost of this work:

Length of road	5,800 feet
Width of macadam	16 feet
Macadam laid	10,311 sq. yds.
Stone in road	2,974 cu. yds.
Stone hauled from cars	2,000 cu. yds.
Stone hauled from storage	974 cu. yds.
Average haul of stone	1 mile
Surface treated with bituminous binder	9,630 sq. yds.
Bituminous binder used	15,900 gallons

Rate of pay: Men, 25 cents; teams, 50 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$ 249.00
Excavation	129.82
Shaping road bed	71.20
Loading stone	252.95
Hauling stone and sand, including rehandling	903.10
Spreading stone	305.40
Trimming shoulders and side roads	156.50
Rolling and sprinkling	250.50
Watchman and miscellaneous labor	366.45
Coal, oil and supplies	31.67
Heating bituminous binder	128.95
Hauling and spreading bituminous binder	80.08
Cost of bituminous binder delivered	1,113.00
Freight on stone	2,419.09
Contractor's profit on hauling stone	1,029.39
Total	$7,487.10

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone on wagons	$0.085
Hauling stone, including rehandling	.304
Spreading stone	.102
Rolling and sprinkling	.084
Watchman and miscellaneous labor	.123
Coal, oil and supplies	.017
Contractor's profit on hauling stone	.345
Total	$1.060
Cost per gallon for applying binder (heating, hauling and spreading)	$0.013

COST PER SQUARE YARD FINISHED WATERBOUND MACADAM.

Superintendence	$0.0242
Excavation	.0112
Shaping road bed	.0069
Trimming shoulders and side roads	.0153
Placing stone	.3045
Freight on stone	.2350
Total	$0.5971

COST PER SQUARE YARD FINISHED BITUMINOUS MACADAM.

Superintendence	$0.0240
Excavation	.0112
Shaping road bed	.0069
Trimming shoulders and side roads	.0159
Placing stone	.3045
Applying bituminous binder	.0217
Cost of bituminous binder	.1155
Freight on stone	.2350
Total	$0.7344

CARMI.

SECTION 2 OF THE FAIR GROUNDS ROAD IN CARMI TOWNSHIP, WHITE COUNTY.

During 1909, a section of macadam was placed on the Fair Grounds road beginning at the southern limits of the city of Carmi, and extending southward for a distance of about a mile. In 1912, an additional section of macadamized road was constructed at the end of the macadam previously placed on this road and extending in a southerly and easterly direction for a total length of 7,600 feet. The country is rolling and a considerable amount of earth work was done to shape the road and prepare it for the macadam.

The macadam for the south mile was constructed of washed gravel bonded with loam, and was made 10 inches wide and 10 inches thick. The gravel was purchased at Evansville, Indiana, and the work was paid from a fund obtained by a special hard road tax.

About 2,500 feet of waterbound macadam was constructed on this section of road, beginning at the end of the old macadam on the road and extending in a southerly direction. This waterbound macadam was made 10 feet wide and 8 inches thick. Stone for the macadam was furnished from the penitentiary at Menard and the work was paid from the special hard road funds.

The gravel macadam, when first placed, did not have any stability and worked out of shape badly under traffic. It is believed that by constant care in raking in the ruts as they form, that the gravel will eventually compact and make a very durable and stable road surface. The work was done under the supervision of the Illinois Highway Commission, but the machinery necessary was furnished by the township.

No detailed statement of the cost of this work is available.

MORRISON.

GROVE STREET ROAD, MT. PLEASANT TOWNSHIP, WHITESIDE COUNTY.

Grove street road is an extension of the Morrison-Sterling road through the city of Morrison, constructed in part 24 feet wide with concrete curb and gutter, and in part 20 feet wide with earth side roads. The roadway is a bituminous macadam, a part of which is placed on top of an existing macadam on the old roadway. The macadam was made 9 inches thick at the crown and 6 inches thick at the curb, the lower course being 3 inches thick at the curb and 6 inches thick at the crown, rolled and bonded with screenings after the manner of the waterbound macadam. The upper course was made 3 inches thick throughout, and was filled with a bituminous binder.

The roadway was somewhat uneven and a considerable amount of excavating was done in order to reach a desirable grade. Wherever the existing macadam on the road could be utilized for the lower course of the roadway, this was done. Stone for the improvement was furnished from the penitentiary at Joliet, and funds for the work were provided by means of a special assessment on the abutting property.

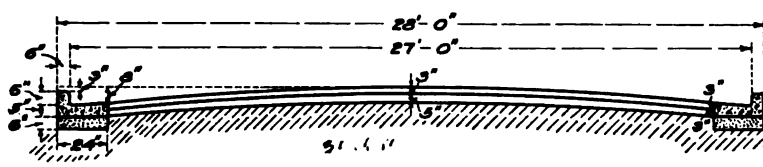


FIG. 11. Cross section of Grove street road, Morrison.

After the upper course of the stone had been rolled, the first application of binder amounting to about one gallon per square yard of surface was applied. This was rolled lightly and ¾-inch clean limestone chips were brushed into the surface voids. A second application of the binder amounting to about one gallon per square yard was then applied, and the surface dusted with sand, rolled and opened for traffic. Several kinds of bituminous compound were used on various sections as follows:

Station.	First coat.	Second coat.
0-2 to 13	No. 164	No. 170
13 to 21+89	No. 166	No. 170
34 to 41	No. 166	No. 163
41 to 48+40	No. 163	No. 163
48+40 to 57	No. 163	No. 190
57 to 60+50	No. 170	No. 190
60+50 to 63+50	No. 190	No. 190
0-2 to 0-7	No. 191	No. 191

Three blocks in the business district were paved with brick on a 6-inch macadam base. A total of 3,682 square yards of brick pavement was laid. The three blocks of brick pavement were filled with asphalt filler No. 165.

The following table is an itemized statement of the cost of this work:

Length of road	5,920 feet
Width of road: 5,340 ft.-24 ft. wide; 580 ft.-20 ft. wide.	
Macadam laid	15,957 sq. yds.
Stone in road	4,320 cu. yds.
Stone hauled from cars	2,820 cu. yds.
Stone hauled from storage	1,500 cu. yds.
Average haul of stone	¾ mile
Surface treated with bituminous binder	15,957 sq. yds.
Bituminous binder used	33,000 gallons
Amount of bituminous binder per square yard of surface	2.1 gallons
Rate of pay: Men, 20 cents; teams, 40 cents per hour. Spreading binder, men, 25 cents per hour.	

COST OF LABOR AND SUPPLIES.

Superintendence	$ 750.00
Excavation	1,163.85
Shaping road bed	164.95
Loading stone	366.85
Hauling stone, including rehandling	1,052.55
Spreading stone	528.08
Rolling and sprinkling	302.00
Watchman and miscellaneous labor	722.10
Coal, oil and supplies	330.72
Heating bituminous binder	248.56
Hauling and spreading bituminous binder	106.15
Cost of bituminous binder delivered	2,700.75
Freight on stone, including demurrage	3,582.02
Total	$12,018.58

COST PER CUBIC YARD FOR PLACING STONE.

Loading stone on wagons	$0.085
Hauling stone, including rehandling	.243
Spreading stone	.122
Rolling and sprinkling	.070
Watchman and miscellaneous labor	.167
Coal, oil and supplies	.078
Total	$0.765
Cost per gallon for applying binder (heating, hauling and spreading)	$0.0108

COST PER SQUARE YARD FINISHED BITUMINOUS MACADAM.

Superintendence	$0.047
Excavation	.073
Shaping road bed	.010
Placing stone	.206
Applying bituminous binder	.022
Cost of bituminous binder	.169
Freight on stone	.224
Total	$0.751

COST OF GROVE STREET IMPROVEMENT COMPLETE.

15,957 sq. yds. bituminous pavement	$12,018.58
12,742 ft. combined curb and gutter @ 44c	5,606.70
One small concrete bridge	111.61
Materials and labor on catch basins and inlets	583.18
Lowering side walks	143.00
3681.9 sq. yds. brick pavement @ $1.43½ + $9.65 Int.	5,293.17
Pitch filler poured, including pouring cans	609.81
Total	$24,366.05

MORRISON.

SECTIONS 1 AND 2 OF THE MORRISON-STERLING ROAD, MT. PLEASANT TOWNSHIP, WHITESIDE COUNTY.

The first work on the Morrison-Sterling road was done during the season of 1910 and began at the city limits of the city of Morrison and extended in an easterly direction for a distance of about one mile. The work was undertaken in the fall of 1910 and was incomplete when weather made it necessary to close. The road was completed in the season of 1911 and an additional section started at the east end, which was finished in the spring of 1912.

Stone for the improvement was furnished from the penitentiary at Joliet. The soil is a yellow clay and black loam and a considerable amount of grading was necessary inasmuch as the road is through rolling country.

A part of the last section of road completed was surfaced with crushed stone prepared at the township quarry, which is operated by the commissioners of Mt. Pleasant Township. This stone, while too soft to make a very durable roadway, is an excellent bonding material for the surface of a harder stone, consequently, it was used for the surface on the last section constructed, and screenings from the local quarry were used throughout the construction of the Morrison-Sterling road. Of this work, 6,000 square yards were completed in 1912.

The following table is a statement of the amount of work which was done on this road, but no itemized statement of the cost is available:

Length of road	9,300 feet
Width of macadam	12 feet
Macadam laid	12,400 sq. yds.
Stone in road	3,800 cu. yds.
Stone hauled from cars	3,000 cu. yds.
Stone crushed at Wildcat quarry	800 cu. yds.
Average haul of stone from quarry, 3 miles from cars	1½ miles

Rate of pay: Men, 20 cents; teams, 40 cents per hour.

Ryan bridge Union and Cottonwood Townships, Cumberland County.

Four 50-foot deck girder spans; roadway, 16 feet. Height finished roadway to bottom of footings, 32 feet. 1,091 lineal feet of piles in foundations. Cost, $9,500.80. Built in 1912. Goggin Construction Co., Arcola, Illinois, contractor. Designed by the Illinois Highway Commission.

MAINTENANCE WORK, 1912.

Mt. Sterling.

WEST CROSS STREET ROAD, MT. STERLING TOWNSHIP, BROWN COUNTY.

Resurfacing.

The Mt. Sterling experimental road was constructed as a tar macadam in the summer of 1909. Frequent service inspections were made on this road, and in 1912 it was decided that the road should be resurfaced in order to insure that its condition would be maintained. The road was still in a very serviceable condition, but the tar originally used in dressing the surface seemed to have lost its life to a certain extent, and as a result the stone had loosened in a few places. In order to prevent this condition becoming any more serious, the resurfacing was undertaken.

The depressions in the surface were repaired by the addition of stone and rolling, and the entire surface painted with a light tar followed by a dressing of coarse sand. On many parts of the road it was necessary to make a second application of tar followed by a second dressing with coarse sand. Binder No. 265 was used.

The following table is an itemized statement of the cost of the work:

Length of road	1,900 feet
Width of road	30 feet
Amount of road resurfaced	6,400 sq. yds.
Amount of bituminous binder used	4,700 gallons
Rate of pay: Men, 15 cents; teams, 35 cents per hour.	
Amount of bituminous binder used per sq. yd. of surface	0.73 gallon

COST OF LABOR AND SUPPLIES.

Superintendence	$ 75.00
Loading, hauling and spreading sand and stone	54.25
Cleaning and reshaping macadam	102.25
Rolling and sprinkling	46.25
Watchman and miscellaneous labor	13.00
Cost of stone and sand	183.16
Coal, oil and miscellaneous supplies	18.55
Cost of bituminous binder, f.o.b. Mt. Sterling	365.80
Heating, hauling and spreading binder	112.00
Total	$970.26
Cost of resurfacing per square yard of surface	$0.152
Cost per square yard yer year	.051

Bushnell.

HURST AND DAVIS STREET ROADS, BUSHNELL TOWNSHIP, MC DONOUGH COUNTY.

In the season of 1909, tar macadam experimental roads were constructed on these two streets in the city of Bushnell. Frequent service inspections were made on these roads, and these reports showed that

the following year the surface began to get somewhat rough and uneven in places, due to the picking out or disintegration of the tar surface. Some sections of the road remained in excellent condition, but in general the road began to deteriorate the second season. In 1911, it was decided to resurface this road, but the work was not reached until 1912. By that time the surface had disintegrated to such an extent that a practically new surface had to be built on Hurst street. Davis street was in somewhat better condition and only a part was entirely resurfaced. The remainder was surface painted with an asphaltic binder to renew the life of the old tar surface.

The portion of Davis street from the pavement south for three blocks, and all of Hurst street, were cleaned by sweeping and flushing with a fire hose until all detritus and mud between the stone was removed so far as possible. The uneven places in the road were loosened by means of a scarifier, new stone added, and the surface rerolled. The entire road surface was then painted with tar, about one-fourth to one-third gallon per square yard of surface being used. This application of tar was then covered with gravel about the size used for roofing, after which the surface was rolled and a second spreading of tar was applied. The second spreading of tar was covered with a torpedo sand and the road opened for traffic. Binder No. 316 was used.

The section of Davis street from the end of the third block to the end of the road was painted with a binder made of three parts binder No. 315 and one part binder No. 284 and covered with torpedo sand.

The following table is an itemized statement of the cost of this work:

Length of road	4,443 feet
Width of road: 3,193 ft.-12 ft. wide; 1,250 ft.-15 ft. wide.	
Amount of road resurfaced	8,512 sq. yds.
Amount of stone used	80 cu. yds.
Amount of bituminous binder used	11,600 gallons
Amount of gravel used	220 tons
Amount of bituminous binder used per square yard of surface.	1.36 gallons

COST OF LABOR AND SUPPLIES.

Superintendence	$150.00
Reshaping road	68.00
Loading and hauling stone and gravel	195.42
Rolling and sprinkling	118.50
Watchman and miscellaneous labor	138.47
Heating bituminous binder	33.53
Hauling and spreading bituminous binder	139.98
Cost of gravel and stone, f.o.b. Bushnell	401.95
Cost of bituminous binder, f.o.b. Bushnell	856.28
Coal, oil and miscellaneous supplies	45.26
Total	$2,147.39
Cost per square yard of surface for resurfacing	$0.253
Cost per square yard per year	.084

EDWARDSVILLE.

MAINTENANCE WORK ON MARINE, TROY AND ST. LOUIS ROADS, EDWARDSVILLE TOWNSHIP, MADISON COUNTY.

The Troy and St. Louis roads were constructed in 1910, and the Marine road in 1911, and all were waterbound macadam constructed with Menard prison stone.

The Troy road is used by a large amount of country traffic. The St. Louis road carries a considerable amount of country traffic, and a section of about 1,500 feet just outside the city limits of Edwardsville carries traffic from a coal mine and brick yard. This section of the St. Louis road has traffic which is too heavy for a waterbound macadam.

The Marine road leads from the pavement down a steep hill, and then across low land, which is occasionally overflowed and the road covered with water.

All of these roads, when inspected in 1912, were in need of some maintenance work, and the commissioners therefore decided to put all of these roads in good condition during this year. All uneven places and ruts in the roads were scarified and reshaped with the addition of crushed stone, then rolled and bonded with screenings. Some work was done throughout the length of all of these roads, but it was not necessary to scarify all of the surface on the roads. The stone for the maintenance work was furnished from the penitentiary at Menard, and the cost of the work was paid by the township commissioners from township funds.

The following table is an itemized statement of the cost of this maintenance work:

Width of road	12 and 16 feet
Amount of road resurfaced	14,271 sq. yds.
Amount of stone used	250 cu. yds.
Length of haul of material	¾ mile

Cost of labor: Men, 22¼ cents; teams, 50 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$105.00
Loading, hauling and spreading stone	312.50
Rolling and sprinkling	124.00
Freight on stone	177.50
Coal, oil and supplies	17.85
Scarifying and reshaping old surface	134.75
Total	$871.60
Cost per square yard of surface repaired	$0.06108
Cost per square yard per year	$0.03 and $0.02

East St. Louis.

TRI-CITY ROAD, VENICE TOWNSHIP, MADISON COUNTY.

Resurfacing.

The Tri-City road was constructed in 1909 on a roadway leading from the Black bridge in East St. Louis north towards Granite City. The nature of the traffic on this road is such that at the time of its construction brick was recommended, but for financial reasons it was impossible to secure the brick construction and a bituminous macadam was built. The action of traffic soon demonstrated that this road was not of a type which would withstand the class and amount of traffic which was using it.

In the season of 1912, this road was repaired and the section from the Black bridge to the Troy & Eastern railroad was entirely reconstructed. From the Troy & Eastern to the north end, only the worst depressions and uneven places were repaired. In the reconstruction of the section from the Black bridge to the Troy & Eastern, some methods were followed which were an improvement over those used when the road was first built, and while the road may not prove, on account of the nature of the traffic, to be of long life, still it is believed that it will last longer than the road as first constructed.

The section of road from the Black bridge to the Troy & Eastern was rebuilt as follows: The depressions in the old tar macadam were filled with stone which was rolled and bonded with screenings, and was then covered with a 4-inch layer of 3-inch stone, which was thoroughly rolled. The voids were then partially filled with ¾-inch washed gravel, and the surface covered with about one gallon per square yard of bituminous binder. This spreading of binder was covered lightly with the ¾-inch gravel which was carefully brushed into the voids, and a second spreading of binder applied at the rate of about one gallon per square yard of surface. ¾-inch gravel was then brushed into the remaining voids in the surface, and a third spreading of bituminous binder, amounting to about one-half gallon per square yard, was applied and the whole thoroughly rolled. The surface was finally covered with torpedo gravel and again rolled. The bituminous binders used were as follows: Station 8 to 15, one gallon per square yard of binder No. 289, followed by 1½ gallon per square yard of binder No. 314. Station 0 to 8, surfaced with binder No. 303. Station 15 to 26, surfaced with binder No. 314.

The patch work from the Troy & Eastern to the north end of the road was done with binder No. 306.

The following table is an itemized statement of the cost of this work:

Amount of macadam resurfaced	**6,300 sq. yds.**
Amount of stone used	**1,090 tons**
Amount of gravel used	**192 tons**
Amount of asphalt used	**8,360 gallons**
Amount of tar used	**3,000 gallons**

Rate of pay: Men, 20 cents; teams, 60 cents per hour.

COST OF LABOR AND SUPPLIES.

Superintendence	$260.00
Cost of gravel delivered National City	171.61
Loading and hauling stone, including rehandling	529.10
Spreading stone and gravel	220.40
Hauling, heating and spreading bituminous binder	295.30
Rolling and sprinkling	169.00
Watchman and miscellaneous labor	321.43
Cost of bituminous binder delivered National City or Venice	745.27
Coal, oil and miscellaneous tools and supplies	73.49
Freight on stone	388.21
Total	$3,173.81

COST PER SQUARE YARD FOR LABOR AND SUPPLIES.

Superintendence	$0.0412
Loading and hauling stone and gravel, including rehandling	.0840
Spreading stone and gravel	.0349
Hauling, heating and spreading bituminous binder	.0470
Rolling and sprinkling	.0268
Watchman and miscellaneous labor	.0510
Cost of bituminous binder delivered	.1180
Freight on stone	.0616
Coal, oil and miscellaneous supplies	.0115
Cost of gravel delivered	.0272
Total	$0.5032

PEKIN.

WEST BLUFF ROAD, HOLLIS TOWNSHIP, PEORIA COUNTY.

The West Bluff road was constructed in 1910 as a tar macadam. The foundation upon which the macadam was constructed was very unsatisfactory, being in part an unsettled fill, and it was realized when the road was completed that it was not as thoroughly compacted in places as was desirable, but the work was done as well as possible with the conditions of the foundations on the road.

It was inevitable that under these conditions some uneven places would develop in the surface of the road, and in 1912, it was deemed advisable to repair and resurface the entire road. On some sections of the road the tar surface was in perfect condition, and on other sections of the road the tar had worn off and left the stone bare. The chips between the stone loosened in places, leaving the road rough. In repairing the road all the uneven places were loosened and filled to the desired shape by means of the addition of stone and rolled. The repair of these uneven places was made by cleaning the depressions, loosening the stone, then painting with an asphaltic binder, after which stone was placed in the depressions, rolled and filled with the asphaltic compound. After all the uneven places in the road had been repaired in this way, the entire surface was painted with about one-half gallon per square yard of surface of a light tar, and covered with coarse sand. Binder No. 276 was used for patching and binder No. 271 for painting the surface.

The following table is an itemized statement of the cost of this work:

Amount of road repaired	7,468	feet
Width of road repaired	16	feet
Square yards treated with bituminous binder	9,400	
Amount of binder used	5,000	gallons
Length of haul for sand and stone	2	miles
Rate of pay: Men, 20 cents; teams, 50-60 cents per hour.		
Amount of binder used per square yard of surface	0.53	gallons

COST OF LABOR AND SUPPLIES.

Superintendence	$ 70.00
Sweeping and cleaning surface	41.05
Loading, hauling and spreading stone to repair holes	21.80
Loading, hauling and spreading sand	156.10
Rolling	60.00
Heating, hauling and spreading binder	134.35
Watchman and miscellaneous labor	109.55
Cost of tar binder, f.o.b. Pekin	495.51
Cost of sand and stone	38.40
Coal, oil and miscellaneous supplies	17.67
Total	$1,144.43

COST PER SQUARE YARD FOR RESURFACING.

Bituminous binder	$0.052
Applying bituminous binder	.026
Other labor and materials	.044
Total	$0.122

PEORIA.

RESURFACING PROSPECT HEIGHTS, RICHWOOD TOWNSHIP, PEORIA COUNTY.

The Prospect Heights road was put under construction in the fall of 1909, but was incomplete at the close of the season and the work was completed during the summer of 1910. Throughout the construction of the road, considerable difficulty was encountered because of the nature of the soil which made a poor foundation. In addition to that, the binder which was used being of fairly heavy grade of petroleum residuum was handled in tank cars and consequently was applied to the road at too low a temperature. But as noted in the report for 1910, the chief source of trouble was due to lack of underdrainage which, although advised by the State Highway Commission, was not put in by the local commissioners until the road had suffered serious damage. As a result, the surface of the road was unsatisfactory on account of its unevenness, and in 1912, other commissioners having been elected, it was decided to restore the road.

The entire road, with the exception of about 1,000 feet at the north end, was scarified and a little stone added so as to bring the surface to the desired cross section and then resurfaced with a bituminous compound. After the road had been prepared and reshaped, about one-half gallon per square yard of the bituminous compound was spread.

The surface was then covered with gravel about the size of roofing gravel which was brushed into the voids and a light coating of bituminous compound amounting to about one-fourth gallon per square yard applied. Torpedo gravel was then spread which was carefully brushed into all the remaining voids in the surface and the road was again covered with about one-fourth gallon per square yard of bituminous compound. It was then covered with torpedo sand and opened for traffic. The 1,000 feet on the north end of the road was cleaned, painted with one-fourth gallon per square yard of surface of binder No. 300 and covered with torpedo gravel.

The binder used was a fluxed binder No. 300 made of 25 per cent of binder No. 284 and 75 per cent of binder No. 292 or No. 276.

The following table is an itemized statement of the cost of this work:

Length of road resurfaced	10,560 feet
Width of road	12 feet
Amount of surface, including intersection	14,280 sq. yds.
Length of haul for gravel and stone	1 mile
Amount of bituminous binder used	14,638 gallons
Rate of pay: Men, 25 cents; teams, 50 cents per hour.	
Amount of binder used per square yard of surface	1.025 gallons

COST OF LABOR AND SUPPLIES.

Superintendence	$ 182.00
Spiking and reshaping surface	71.94
Loading and hauling gravel and stone	578.77
Spreading stone, sand and gravel	461.03
Rolling	327.75
Trimming shoulders and side roads	227.04
Watchman and miscellaneous labor	417.76
Coal, oil and supplies, including tools	191.11
Gravel and stone, including freight	714.82
Hauling bituminous binder	72.95
Heating and spreading bituminous binder	376.23
Cost of bituminous binder	1,171.04
Total	4,792.44

COST PER SQUARE YARD FOR RESURFACING.

Bituminous binder	$0.0824
Applying bituminous binder	.0315
Other labor and materials	.2217
Total	$0.3356

OLNEY.

RESURFACING CEMETERY ROAD, OLNEY TOWNSHIP, RICHLAND COUNTY.

The Cemetery road was constructed as a waterbound macadam in the fall of 1908 and in the spring of 1909. After its completion very little work in the way of maintenance had been done upon it. In the summer of 1912 it was decided to resurface this road throughout. The mud which had accumulated on the surface of the road was removed

Ryan bridge, Union and Cottonwood Townships, Cumberland County.

when the surface was found to be in fairly good condition. This mud had accumulated partly on account of the vehicles pulling it onto the macadam from adjoining unpaved roads and partly due to the fact that in cleaning the gutters alongside the roads, a considerable amount of mud was thrown back onto the roadway itself.

All uneven places in the macadam were loosened up and filled with stone so as to bring the surface to the desired shape. Some sections of the road were loosened up for the entire width, while other sections were loosened where the traffic had worn a rut into the surface. The entire roadway was then covered and bonded with screenings. After the screenings had been placed and bonded, it was covered to a depth of ¾ inch with a good grade of bonding gravel, which was watered and rolled.

The following table is an itemized statement of the cost of this work:

Length of road resurfaced	5,000 feet
Width of road: 2,500 ft.-16 ft. wide; 2,500 ft.-12 ft. wide.	
Amount of road resurfaced	7,700 sq. yds.
Amount of stone used	220 cu. yds.
Amount of gravel used	150 cu. yds.
Length of haul for materials	½ mile
Rate of pay: Men, 17½ cents; teams, 35 cents per hour.	

COST OF LABOR AND SUPPLIES.

Superintendence	$150.00
Cleaning and reshaping old surface	75.00
Loading, hauling and spreading stone and gravel	156.65
Rolling and sprinkling	90.00
Freight on stone	188.89
Cost of gravel delivered Olney	110.74
Coal, oil and supplies	16.10
Total	$787.38
Cost of resurfacing per square yard of macadam	$0.102
Cost per square yard per year	.034

TABLE NO. 26.

Cost data of experimental macadam construction—1910-11-12.

Where built.	Arrowsmith.	Beardstown.	Bridgeport.	Collinsville.	Donovan.	Earlville.	Edwardsville.	Effingham.	Franklin Grove.	Grant Park.	Jerseyville.	Morrison.	New Philadelphia.	O'Fallon.	O'Fallon.	Paxton.	Peoria.	Pekin.	Springfield.	Sollitt.	Walnut.
Year built	1910.																				
Cost per cu. yd. for placing stone:																					
Loading stone	.169	.095	.101	.213	.099	.022	.125	.021	[1].771	.254	.....	.133	.042	.041	.072	.082	.027	.122	.134	.261	.089
Hauling stone	.216	.440	.290	.664	.269	.464	.447	.172	.441	.400	.440	.381	.202	.245	.525	.461	.586	.416	.202	.289	.416
Spreading stone	.113	.101	.099	.095	.086	.021	.059	.081	.....	.....	.154	.086	.081	.067	.104	.128	.162	.133	.071	....	.064
Rolling and sprinkling	.067	.054	.029	.105	.032	.137	.098	.049	.040	.056	.123	.070	.029	.282	.079	.072	.108	.045	.057	.067	.038
Watchman and miscellaneous labor	.028	.017	.061	.062	.016	.025	.029	.053	.....	.083	.103	.019	.036	.059	.066	.014	....	.073	.060	.072	.033
Coal, oil and supplies	.035	.035	.028	.028	.047	.029	.021	.036	.022	.045	.024	.023	.021	.012	.023	.033	.044	.007	.015	.022	.034
Total	.628	.742	.608	1.167	.549	.698	.779	.412	.833	.838	.844	.712	.411	.706	.869	.790	.927	.796	.539	.711	.674
Labor cost per sq. yd. finished macadam:																					
Superintendence	.031	.015	.011	.037	.015	.012	.023	.021	.018	.032	.049	.023	.018	.014	.028	.012	.052	.014	.035	.028	.018
Excavation	.050	.020	.217	.093	.041	.021	.170	.014	.....	.....	.....	.066	.003	.009	.063	.....	.109	.022	.021	....	.084
Shaping road-bed	.026	.016	.019	.009	.017	.001	.026	.005	.058	.....	.048	.005	.011	.007	.018	.016	.041	.035	.012	....	.002
Trimming shoulders	.027	.014	.017	.008	.008	.003	.010	.010	.049	.....	.007	.006	.001	.010	.009	.....	.027	.018	.0002	....	.020
Placing stone	.174	.195	.166	.383	.146	.173	.208	.147	.302	.300	.294	.188	.151	.157	.297	.127	.328	.308	.226	.216	.184
Applying bituminous binder	.....	.024	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.032	.021	.....	.019	.022	.014	.012	....	....
Applying gravel binder	.....	.....	.....	.....	.....	.005	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	....	....	.....	.001	....
Total	.308	.284	.430	.530	.227	.215	.437	.197	.427	.332	.398	.288	.216	.218	.415	.174	.570	.411	.3062	.245	.308

[1]Including spreading and hauling stone.

Table No. 26—Continued.

Where built.	Beardstown.	Bridgeport.	Casey.	Crescent City.	DeKalb.	Donovan.	Edwardsville.	Franklin Grove.	Grant Park.	Lebanon.	Oblong.	O'Fallon.	Robinson.	Shawneetown.
Year built	1911.													
Cost per cu. yd. for placing stone:														
Loading stone	.142	.181	.103	.085	.527	.150	.111	.098	.....	.102	.131	.153	.204	[1].438
Hauling stone	.503	.559	.270	.227	.....	.445	.327	.781	.437	.382	.492	.392	.926	.....
Spreading stone	.092	.091	.061	.085	[2].503	.103	.094	.114	.135	.1155	.089	.103	.129	.076
Rolling and sprinkling	.111	.113	.089	.130	.050	.097	.160	.098	.046	.0555	.060	.125	.095	.043
Watchman and miscellaneous labor	.028	.024	.....	.022	.....	.....	.027	.021	.....	.063	.099	.078	.021	.031
Coal, oil and supplies	.022	.031	.021	.039	.025	.053	.014	.021	.025	.029	.018	.014	.024	.026
Total	.898	.999	.544	.588	1.105	.848	.733	1.133	.643	.747	.889	.865	1.399	.614
Labor cost per sq. yd. finished macadam:														
Superintendence	.034	.025	.018	.022	.....	.045	.067	.010	.031	.010	.026	.023	.027	.022
Excavation	.116	.080	.046	.036	.....	.081	.664	.....	.....	.093	[3].107	.024	.....	.040
Shaping road-bed	.015	.020	.019	.020	.....	.028	.049	.009	.016	.025	.....	.005	.046	.025
Trimming shoulders	.003	.021	.021	.005	[3].094	.028	.066	.....	.....	.022	.....	.011	.043	.002
Placing stone	.248	.287	.173	.206	.312	.272	.269	.287	.209	.284	.281	.255	.358	.203
Applying bituminous binder	.022	.....	.....	.019	.....	.....	.....	.....	.....	.022	.017	.033	.....	.....
Applying gravel binder	.....	.....	.....	.....	.....	.....	.....	.006	.....	.....	.....	.....	.....	.003
Total	.438	.433	.277	[a].289 [b].308	.406	.454	1.115	.312	.256	.456	.431	.351	.474	.295

[a] Waterbound.
[b] Bituminous.
[2] Includes hauling stone.
[3] Includes shaping road-bed.

Table No. 26

Where built.	Bloomington.	Bridgeport.	Cairo (Willard).	Cairo (Half Way).	Carbondale.	Sec. 2, Collinsville-Troy.	Sec. 2, Collinsville-East St. Louis.	Effingham.	Fairbury.	Geneseo.
Year built	1912.									
Cost per cu. yd. for placing stone:										
Loading stone	.111	.193	.062	.075	.051	[1].329	.....	[1].290	.080	.082
Hauling stone	.522	.914	.356	.257	.264	.....	.528	.....	.206	.478
Spreading Stone	.108	.114	.061	.054	.087	.118	.074	.069	.057	.072
Rolling and sprinkling	.066	.078	.048	.088	.035	.072	.065	.050	.061	.092
Watchman and miscellaneous labor	.139	.085	.055	.015	.100	.065	.054	.034	.042	.081
Coal, oil and supplies	.027	.025	.014	.038	.038	.010	.021	.021	.029	.051
Total	.973	1.409	.596	.527	.575	.594	.742	.464	.475	.856
Labor cost per sq. yd. finish'd macadam:										
Superintendence	.049	.036	.020	.030	.018	.037	.044	.017	.044	.034
Excavation	.047	.128	.....	.011	.044	.082	.146	.021	.085	....
Shaping road-bed	.035	.044	.018	.017	.025	.034	.014	.013	.018	.033
Trimming shoulders	.017	.040	.....	.002	.006	.022	.012	.015	.005	.019
Placing stone	.367	.498	.213	.182	.223	.256	.318	.207	.166	.307
Applying bituminous binder	.025	.....	.....	.....	.....	.....	.....	.....	.....	....
Applying gravel binder	.....	.....	.050	.....	.011	.....	.....	.....	.....	....
Total	.540	.746	.301	.242	.327	.431	.534	.273	.318	.393

[1] Includes hauling stone.
a Waterbound.
b Bituminous.

—Concluded.

Gibson City.	Hindsboro.	Sec. 2, Lincoln.	Cairo (Mound City).	Malta.	Mattoon.	Momence.	Morrison (Grove st.).	Palestine.	Pekin (Cemetery).	Sibley.	Shermerville.	Troy.	Wateeka.	Whitehall.
						1912.								
.105	[2].500	.357	.078	.062	.107	.052	.085	[2].378	.085	.159	[2].395	[2].300	.087	.133
253	.....	.....	.295	.692	.388	.263	.243	.....	.304	.398	.....	.....	.540	.441
.094	.069	.085	.079	.127	.207	.094	.122	.078	.102	.095	.093	.077	.084	.109
.034	.063	.031	.084	.047	.090	.103	.070	.038	.084	.063	.046	.040	.070	.138
.045	.038	.026	.063	.072	.125	.094	.167	.....	.123	.011	.012	.050	.062	.017
.049	.041	.021	.040	.048	.057	.047	.078	.017	.017	.033	.030	.023	.026	.027
.580	.711	.520	.639	1.048	.974	.653	.765	.511	.715	.759	.576	.490	.869	.865
.022	.020	.028	.017	.032	.028	.051	.047	.006	.024	.026	.025	.028	.031	.062
.012	.077	.026	.....	.100	.048	.029	.073	.003	.011	.110	.064	.028	.057	.081
.014	.007	.017	.008	.035	.025	.012	.010	.011	.007	.022	.025	.019	.012	.005
.....	.....	.006	.003	.020	.004	.004	.....	.002	.016	.004	.014	.025	.008	.007
.207	.250	.191	.095	.345	.278	.208	.206	.132	.305	.259	.235	.171	.248	.252
.024	.....	.....	.029	.....	.027	.025	.022	.....	.022	.....	.....	.....	.....	.028
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.279	.354	.268	.152	.532	.410	.329	.358	.154	[a].363 [b].385	.421	.363	.271	.356	.....

Ryan bridge, Union and Cottonwood Townships, Cumberland County.

This view of the back of the west abutment shows clearly the relative proportions of girders, floor slab and rails.

ROAD TRAFFIC CENSUS.

The necessity for studying traffic conditions is generally recognized by road engineers everywhere, and more attention is being paid each year to such statistics. The first systematic traffic census on country roads was undertaken by the Illinois Highway Commission in 1906, and continued in subsequent years. In the reports for these years will be found the results of the census taken at that time. During 1910, 1911 and 1912 the census has been continued at a number of points where the traffic had previously been observed, and the results of observations taken in these years are given herewith.

The method of taking the traffic census in 1912 has been the same as followed in previous years, and there are here repeated the form of traffic sheet, reduced in size, and the instructions issued to traffic observers. The form has been made as simple as possible, with the expectation that the traffic would be taken by untrained observers. As a matter of fact, the majority of the observers are women, frequently assisted by their children. A dollar for a day's record is paid each observer, and the results obtained have been satisfactory in every way.

The rapidly changing traffic conditions on our roads, from the horse-drawn vehicle to the motor vehicle, requires on our main roads different and more expensive types of construction than were before necessary. As an illustration of the change taking place on some of the roads in Illinois, mention could be made of the traffic census taken on the road leading from Chicago to Clinton. At Dixon and DeKalb observations of the traffic were taken in 1907. In 1912 observations were also taken on this road at DeKalb, Dixon, Wheaton, Ashton, Sterling, Geneva, Lombard and Maple Park. All of these stations are outside of the villages and towns named, and include therefore what may be called strictly country road traffic as distinguished from local village traffic.

At the DeKalb station in 1907 the automobiles were 4 per cent of the total traffic, while in 1912 at the same point they were 50 per cent. At Dixon in 1907 the motor traffic constituted 2 per cent of the total traffic; in 1912, 33 per cent. Also in 1912 at Wheaton the motor traffic was 63 per cent; at Ashton, 34 per cent; at Sterling, 34 per cent; at Geneva, 58 per cent; at Lombard, 55 per cent; and at Maple Park, 66 per cent; these percentages being averages of observations taken four days each in May, June, August and September in 1912.

Form No. 12

STATE OF ILLINOIS HIGHWAY COMMISSION.
TRAFFIC RECORD.

Observer. Date Road

Address Condition of Road: Leading Into:

HOURS AND WEATHER.	IN		OUT	
	LOADED	UNLOADED	LOADED	UNLOADED
6 A. M.				
7 A. M.				
8 A. M.				
9 A. M.				
10 A. M.				
11 A. M.				
12 M.				
1 P. M.				
2 P. M.				
3 P. M.				
4 P. M.				
5 P. M.				
6 P. M.				

REMARKS MAY BE MADE ON OPPOSITE SIDE OF THIS SHEET.

FIG. 12.

The increase here indicated has taken place in the past five years. When it is recalled that road improvement has not begun in Illinois in a systematic way, and that the inducements for motor traffic are far less than in many other sections of the country, it is seen how difficult it is to predict what will be the growth in the future of this traffic, should a system of well-built roads be available for its use. The conclusion can be drawn, however, that any plan for systematic road work in many parts of the State must consider that a large majority of the traffic of the future will be motor traffic.

In particular there is a vast field for the development of motor truck traffic, a class of traffic that it has not been necessary heretofore to consider in plans for road improvement. It is believed that in many sections of the State the opportunity is big for the ultimate development of this class of traffic, and provision should be made in the future road building on a majority of the main roads for the eight and ten ton motor truck.

INSTRUCTIONS FOR TAKING TRAFFIC CENSUS.

Read these instructions carefully; if any point is not clearly understood, write for further information to the State Highway Commission, Springfield, Ill.

1. The observer should sign his or her name at the top of the record sheet in the proper space as indicated.
2. Fill in the date on which the record is taken.
3. In the space under "Condition of Road," state whether the road is dry and smooth, dry and rutted, frozen and smooth, frozen and rough, wet, with six inches of mud (or whatever may be about the depth of the mud). Do not state the condition of the road until the day is ended and then state as above directed the general condition for the entire day, using the words which best describe the actual conditions.
4. In the column headed "Hours and Weather," state each hour the condition of the weather as, "cloudy," "rainy," "fair," etc.
5. All vehicles going "IN" are those going towards town. All vehicles going "OUT" are those going away from town.
6. All passenger vehicles, as carriages and buggies, are to be classed as "unloaded."
7. All wagons carrying any load will be classed as "loaded;" otherwise as "unloaded."
8. The method of recording the traffic is as follows: If a two-horse vehicle passes, put down a small figure 2 opposite the proper hour and in the correct column. If going in (or toward town), the figure should be placed on the left side of the sheet in the column headed "Loaded" or "Unloaded," as the case may be. A carriage of any kind should always be recorded as "unloaded," whether all the seats are occupied or not. Make an "A" for each automobile.
9. Aim to keep your record as clean and neat as possible. Use a medium hard pencil. Keep the pencil point sharp and do not moisten it.
10. Make your fingers small and close together.
11. Each time that a record of traffic is to be taken you will be notified two days in advance of the date on which the record is to be taken.
12. As soon as the record for the day is completed, place it in the stamped and addressed envelope and mail it not later than the following day.

TABLE

Synopsis of traffic census, showing total number

Location of station.	Name of observer.	Station Number.	1910. January. Mon., 17. Motor.	Mon., 17. Horse drawn.	Sat., 22. Motor.	Sat., 22. Horse drawn.	Wed., 26. Motor.	Wed., 26. Horse drawn.
Springfield, Pawnee road	Olga Aarup	1	.....	.....	.....	.....	.....	.....
Springfield, Clear Lake road	Mrs. C. Colesar	2	.....	.....	.....	.....	.....	.....
Sullivan, East road	Mrs. Sam. T. Miller	14	.....	.....	.....	.....	.....	.....
McLean, Heyworth road	Mrs. H. L. VanNess	17	.....	.....	.....	.....	.....	.....
Rock Island, Cemetery road	Paul J. Young	35	.....	.....	.....	.....	.....	.....
Springfield, Peoria road	Fred Brooks	36	.....	.....	.....	.....	.....	.....
Greenville, Wisetown road	Ray VanDeusen	59	.....	.....	.....	.....	.....	.....
Lincoln, Fair grounds road	Margaret Gluick	65	.....	.....	.....	.....	.....	.....
Jerseyville, Fieldon road	Leona Snell	73	.....	.....	0	136	4	134
East St. Louis, Tri-City road	Walter Hunter	74	.....	.....	.....	145	.....	242
Morris	Mrs. Cad Ryder	75	.....	.....	.....	354	2	311
Bement, Bement road	Mrs. J. F. Stoner	76	.....	.....	.....	171	.....	101
Rushville, State road	Mrs. Eph. Abbott	77	0	68	0	212	0	147
O'Fallon, Shiloh road	W. S. Scott	79	.....	.....	.....	.....	.....	.....
Bridgeport, Sumner road	Mrs. L. T. Lawson	80	.....	.....	.....	.....	.....	.....
Earlville	Mrs. Emily C. Taylor	81	.....	.....	.....	.....	.....	.....
Mt. Sterling, W. Cross street	E. E. Clark	83	.....	.....	.....	.....	.....	.....
Bloomington, Springfield road	Wm. H. Hardway	84	.....	.....	.....	.....	.....	.....

NO. 27.

of vehicles passing on dates given—1910-1911.

1910.

February.						March.							
Fri., 18.		Sat., 19.		Mon., 28.		Tue., 1.		Thur., 24.		Fri., 25.		Sat., 26.	
Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.
0	46	0	112	0	82	0	104	0	70	0	94	0	167
2	88	.....	148	13	224	3	170	14	159	25	148	24	185
0	99	0	154	0	134	0	80	14	108	18	143	.....	124
2	240	2	222	2	253	1	247	17	326	27	314	18	315
0	216	0	321	0	35	0	254	11	286	18	307	12	377
0	137	0	156	0	156	0	121	15	160	10	162	11	174
0	72	0	144	2	159	0	85	6	102	6	86	6	139
.....	106	.....	110	7	181	5	126	15	215	11	180	8	187
5	314	5	508	2	462	.....	347	35	298	26	274	14	364
.....	169	.....	200	.....	96	.....	91	12	163	12	139	1	8
0	171	0	276	0	160	0	166	12	212	12	184	0	259
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

Table No. 27

Location of station.	Name of observer.	Station number.	1910. April. Thur., 21. Motor.	Thur., 21. Horse drawn.	Fri., 22. Motor.	Fri., 22. Horse drawn.
Springfield, Pawnee road	Olga Aarup	1	0	114	0	83
Springfield, Clear Lake road	Mrs. C. Colesar	2				
Sullivan, East road	Mrs. Sam. T. Miller	14	18	170	5	102
McLean, Heyworth road	Mrs. H. L. VanNess	17	8	107	1	87
Rock Island, Cemetery road	Paul J. Young	35	27	268	17	205
Springfield, Peoria road	Fred Brooks	36				
Greenville, Wisetown road	Ray VanDeusen	59	22	360	2	335
Lincoln, Fair grounds road	Margaret Gluick	65	12	164	0	124
Jerseyville, Fieldon road	Leona Snell	73				
East St. Louis, Tri-City road	Walter Hunter	74				
Morris	Mrs. Cad Ryder	75	29	329	4	146
Bement, Bement road	Mrs. J. F. Stoner	76	7	108	3	71
Rushville, State road	Mrs. Eph. Abbott	77	3	165	2	124
O'Fallon, Shiloh road	W. S. Scott	79				
Bridgeport, Sumner road	Mrs. L. T. Lawson	80				
Earlville	Mrs. Emily C. Taylor	81				
Mt. Sterling, W. Cross street	E. E. Clark	83				
Bloomington, Springfield road	Wm. H. Hardway	84				

Table No. 27

Location of station.	Name of observer.	Station number.	1910. November. Tue., 29. Motor.	Tue., 29. Horse drawn.	Wed., 30. Motor.	Wed., 30. Horse drawn.
Springfield, Pawnee road	Olga Aarup	1	0	79	0	70
Springfield, Clear Lake road	Mrs. C. Colesar	2				
Sullivan, East road	Mrs. Sam. T. Miller	14	5	163	3	163
McLean, Heyworth road	Mrs. H. L. VanNess	17	0	111	0	106
Rock Island, Cemetery road	Paul J. Young	35	32	271	22	361
Springfield, Peoria road	Fred Brooks	36				
Greenville, Wisetown road	Ray VanDeusen	59	3	288	6	246
Lincoln, Fair grounds road	Margaret Gluick	65	4	157	0	173
Jerseyville, Fieldon road	Leona Snell	73	14	161	10	126
East St. Louis, Tri-City road	Walter Hunter	74				
Morris	Mrs. Cad Ryder	75	37	246	11	204
Bement, Bement road	Mrs. J. F. Stoner	76	0	87	0	82
Rushville, State road	Mrs. Eph. Abbott	77				
O'Fallon, Shiloh road	W. S. Scott	79	0	109	0	175
Bridgeport, Sumner road	Mrs. L. T. Lawson	80	0	119	2	147
Earlville	Mrs. Emily C. Taylor	81	3	266	4	154
Mt. Sterling, W. Cross street	E. E. Clark	83				
Bloomington, Springfield road	Wm. H. Hardway	84				

—Continued.

1910.

September.						October.							
Thur., 22.		Fri., 23.		Sat., 24.		Thur., 20.		Sat., 22.		Fri., 28.		Sat., 29.	
Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.
0	122	0	122	0	125	0	68	.....	.....	0	80	.....	.....
20	193	4	104	48	228	12	157	.....	.....	8	132	.....	.....
20	142	0	94	0	96	10	111	.....	.....	4	59	.....	.....
40	443	12	301	11	379	22	304	.....	.....	20	398	.....	.....
31	437	0	291	3	513	31	951	.....	.....	14	324	.....	.....
11	203	2	121	6	195	5	16	.....	.....	3	137	.....	.....
35	133	0	87	0	256	7	81	.....	.....	.....	.....	8	183
86	413	8	275	18	417	3	216	.....	.....	17	293	.....	.....
16	159	1	85	.....	104	16	169	.....	.....	9	140	.....	.....
0	69	0	62	0	31	.....	.....	0	142	0	67	.....	.....
1	157	15	256	0	150	16	139	.....	.....	14	126	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

—Continued.

1911.

February.

Sat., 11.		Mon., 13.		Thur., 23.		Fri., 24.		Sat., 25.		Mon., 27.	
Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.
0	125	.....	.....	.....	.....	0	68	0	84	.....	.....
.....	.....	.....	.....	0	291	0	570	0	390	.....	.....
.....	.....	.....	.....	4	87	4	130	5	150	.....	.....
0	113	.....	.....	0	107	0	107	0	107	.....	.....
3	319	.....	.....	6	248	12	342	7	323	.....	.....
.....	.....	.....	.....	0	21	0	26	0	27	.....	.....
7	578	.....	.....	0	299	0	321	0	409	.....	.....
0	188	.....	.....	0	161	0	161	2	219	.....	.....
8	200	.....	.....	.....	112	2	89	.....	110	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	262	.....	314	2	357	.....	582	.....	.....
0	110	.....	.....	0	147	0	151	0	205	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
0	77	.....	.....	.....	.....	0	49	0	52	0	25
0	71	.....	.....	0	72	0	111	0	102	.....	.....
2	433	.....	.....	2	416	0	226	0	391	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

Table No. 27

Location of station.	Name of observer.	Station number.	1911. March. Thur., 30. Motor.	Thur., 30. Horse drawn.	Fri., 31. Motor.	Fri., 31. Horse drawn.
Springfield, Pawnee road	Olga Aarup	1	0	144	0	153
Springfield, Clear Lake road	Mrs. C. Colesar	2	0	443	.....	473
Sullivan, East road	Mrs. Sam. T. Miller	14	1	135	12	188
McLean, Heyworth road	Mrs. H. L. VanNess	17	0	95	18	108
Rock Island, Cemetery road	Paul J. Young	35	9	229	13	284
Springfield, Peoria road	Fred Brooks	36	0	71	0	128
Greenville, Wisetown road	Ray VanDeusen	59	2	279	0	245
Lincoln, Fair grounds road	Margaret Gluick	65	4	170	17	230
Jerseyville, Fieldon road	Leona Snell	73	22	149	2	102
East St. Louis, Tri-City road	Walter Hunter	74	.....	.....	.....	.....
Morris	Mrs. Cad Ryder	75	4	202	11	263
Bement, Bement road	Mrs. J. F. Stoner	76	6	148	17	143
Rushville, State road	Mrs. Eph. Abbott	77	.....	.....	.....	.....
O'Fallon, Shiloh road	W. S. Scott	79	0	53	0	51
Bridgeport, Sumner road	Mrs. L. T. Lawson	80	0	70	10	152
Earlville	Mrs. Emily C. Taylor	81	5	184	19	184
Mt. Sterling, W. Cross st.	E. E. Clark	83	.....	.....	.....	.....
Bloomington, Springfield road	Wm. H. Hardway	84	.....	.....	.....	.....

Table No. 27

Location of Station.	Name of observer.	Station number.	1911. May. Thur., 18. Motor.	Thur., 18. Horse drawn.	Fri., 19. Motor.	Fri., 19. Horse drawn.	Sat., 20. Motor.	Sat., 20. Horse drawn.
Springfield, Pawnee road	Olga Aarup	1	0	85	0	136	0	118
Springfield, Clear Lake road	Mrs. C. Colesar	2	0	584	0	594	0	795
Sullivan, East road	Mrs. Sam. T. Miller	14	28	166	19	140	18	128
McLean, Heyworth road	Mrs. H. L. VanNess	17	14	132	7	111	5	117
Rock Island, Cemetery road	Paul J. Young	35	54	415	86	426	60	492
Springfield, Peoria road	Fred Brooks	36	11	114	6	80	9	94
Greenville, Wisetown road	Ray VanDeusen	59	14	368	18	414	19	347
Lincoln, Fair grounds road	Margaret Gluick	65	16	189	18	231	0	167
Jerseyville, Fieldon road	Leona Snell	73	23	95	39	139	24	130
East St. Louis, Tri-City road	Walter Hunter	74	.....	.....	.....	.....	.....	.....
Morris	Mrs. Cad Ryder	75	60	324	48	258	50	313
Bement, Bement road	Mrs. J. F. Stoner	76	30	153	24	341	14	272
Rushville, State road	Mrs. Eph. Abbott	77	.....	.....	.....	.....	.....	.....
O'Fallon, Shiloh road	W. S. Scott	79	0	32	0	74	0	60
Bridgeport, Sumner road	Mrs. L. T. Lawson	80	9	280	10	195	16	232
Earlville	Mrs. Emily C. Taylor	81	16	109	20	132	12	186
Mt. Sterling, W. Cross street	E. E. Clark	83	.....	.....	.....	.....	.....	.....
Bloomington, Springfield road	Wm. H. Hardway	84	.....	.....	.....	.....	.....	.....

—Continued.

1911.

April.

Sat., 1.		Mon., 17.		Tues., 18.		Wed., 19.	
Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.
0	255	0	189	0	130	0	174
0	563	0	525	0	247	0	499
18	217	13	167	6	135	5	148
9	120						
31	274	40	280	18	267	43	295
4	119	2	98	0	78	0	77
10	395	0	390	0	210	0	406
18	227	16	218	16	297	6	286
22	234	17	159		69		179
33	382	39	293	61	260	6	192
23	202	17	176	1	110	0	115
0	77	0	73	0	54	0	62
10	150	4	192	0	99	0	83
12	232	31	141	27	109	8	168

—Continued.

1911.

May.		July.											
Mon., 22.		Mon., 17.		Tue., 18.		Wed., 19.		Mon., 24.		Tue., 25.		Wed., 26.	
Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.
		0	109	0	150	0	50						
		0	715	0	693	0	488						
		32	261	31	345	14	196						
		23	132	26	142	16	146						
		77	446	70	473	69	421						
		17	353	31	437	20	332						
		8	195	21	265	6	205						
		26	173	28	172	10	136						
								46	164	83	361	84	397
		21	165	27	207	2	192						
		0	89	0	76	0	60						
		30	281	26	264	14	224						
		35	190	34	210	55	236						

Table No. 27

Location of station.	Name of observer.	Station number.	1911. September. Fri., 22. Motor.	Fri., 22. Horse drawn.	Sat., 23. Motor.	Sat., 23. Horse drawn.	Wed., 27. Motor.	Wed., 27. Horse drawn.	Thur., 28. Motor.	Thur., 28. Horse drawn.
Springfield, Pawnee road....	Olga Aarup.....	1	....	.....	....	.....	....	.....	.....	.....
Springfield, Clear Lake road.	Mrs. C. Colesar.....	2	....	.....	....	.....	....	.....	.....	.....
Sullivan, East road.....	Mrs. Sam. T. Miller..	14	....	.....	....	.....	....	.....	.....	.....
McLean, Heyworth road....	Mrs. H. L. VanNess .	17	....	.....	....	.....	....	.....	.....	.....
Rock Island, Cemetery road.	Paul J. Young.....	35	....	.....	....	.....	....	.....	.....	.....
Springfield, Peoria road.....	Fred Brooks.....	36	....	.....	....	.....	....	.....	.....	.....
Greenville, Wisetown road..	Ray VanDeusen.....	59	....	.....	....	.....	....	.....	.....	.....
Lincoln, Fair grounds road..	Margaret Gluick.....	65	....	.....	....	.....	....	.....	.....	.....
Jerseyville, Fieldon road	Leona Snell.....	73	....	.....	....	.....	....	.....	.....	.....
East St. Louis, Tri-City road	Walter Hunter	74	....	.....	....	.....	....	.....	.....	.....
Morris.....	Mrs. Cad Ryder	75	....	.....	....	.....	....	.....	.....	.....
Bement, Bement road	Mrs. J. F. Stoner	76	....	.....	....	.....	....	.....	.....	.....
Rushville, State road	Mrs. Eph. Abbott ...	77	....	.....	....	.....	....	.....	.....	.....
O'Fallon, Shiloh road.....	W. S. Scott.....	79	....	.....	....	.....	....	.....	.....	.....
Bridgeport, Sumner road....	Mrs. L. T. Lawson...	80	....	.....	....	.....	....	.....	.....	.....
Earlville.....	Mrs. Emily C. Taylor	81	....	.....	....	.....	....	.....	.....	.....
Mt. Sterling, W. Cross street.	E. E. Clark.....	83	....	.....	....	.....	....	.....	.....	.....
Bloomington, Springfi'd road	Wm. H. Hardway...	84	....	.....	....	.....	....	.....	.....	.....

Table No. 27

Location of station	Name of observer.	Station number.	1911. November. Thur., 16. Motor.	Thur., 16. Horse drawn.	Fri., 17. Motor.	Fri., 17. Horse drawn.	Sat., 18. Motor.	Sat., 18. Horse drawn.
Springfield, Pawnee road.....	Olga Aarup.....	1	0	55	0	26	0	100
Springfield, Clear Lake road.....	Mrs. C. Colesar.....	2	0	588	0	418	0	798
Sullivan, East road.....	Mrs. Sam. T. Miller..	14	26	192	1	76	3	240
McLean, Heyworth road.....	Mrs. H. L. VanNess .	17	4	77	0	89	0	106
Rock Island, Cemetery road.....	Paul J. Young.....	35	12	275	6	202	16	264
Springfield, Peoria road.....	Fred Brooks.....	36	0	77	0	54	0	91
Greenville, Wisetown road	Ray VanDeusen.....	59	7	259	0	218	4	325
Lincoln, Fair grounds road.....	Margaret Gluick	65	7	183	.....	184	5	188
Jerseyville, Fieldon road	Leona Snell.....	73	20	191	1	102	4	177
East St. Louis, Tri-City road.....	Walter Hunter	74	.....	.....	.....	.....	.....	.....
Morris.....	Mrs. Cad Ryder	75	7	368	14	201	6	288
Bement, Bement road.....	Mrs. J. F. Stoner	76	0	151	0	80	0	153
Rushville, State road.....	Mrs. Eph. Abbott ...	77	.....	.....	.....	.....	.....	.....
O'Fallon, Shiloh road.....	W. S. Scott.....	79	0	51	0	39	0	62
Bridgeport, Sumner road.....	Mrs. L. T. Lawson...	80	2	108	0	79	0	127
Earlville.....	Mrs. Emily C. Taylor	81	0	247	0	124	0	164
Mt. Sterling, W. Cross street.....	E. E. Clark.....	83	10	378	.....	230	.....	389
Bloomington, Springfield road....	Wm. H. Hardway...	84	.....	.....	.....	.....	.....	.....

—Continued.

1911.

October.

Tue., 3.		Wed., 4.		Thur., 5.		Tue., 10.		Wed., 11.		Thur., 12.	
Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.
0	142	0	158	0	192	.....	.....	.....	.....	.....	.....
0	879	0	100	0	938	.....	.....	.....	.....	.....	.....
9	204	15	180	19	196	.....	.....	.....	.....	.....	.....
2	100	4	128	4	122	.....	.....	.....	.....	.....	.....
20	307	40	336	21	316	.....	.....	.....	.....	.....	.....
0	49	0	51	0	64	.....	.....	.....	.....	.....	.....
19	295	20	423	19	397	.....	.....	.....	.....	.....	.....
1	166	1	173	14	269	.....	.....	.....	.....	.....	.....
11	121	15	156	27	186	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
7	326	11	485	10	545	.....	.....	.....	.....	.....	.....
0	161	0	178	2	152	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
0	90	0	139	0	61	.....	.....	.....	.....	.....	.....
0	150	0	148	1	196	.....	.....	.....	.....	.....	.....
0	133	0	63	4	149	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	53	456	43	550	36	495
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

—Concluded.

1911.

December.

Wed., 27.		Thur., 28.		Fri., 29.		Sat., 30.		Sun., 31.	
Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
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.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	65	2	63	6	67	.....	63	2	20

TABLE

Synopsis of traffic census, showing total

Location of station.	Name of observer.	Station number.	January.			
			Mon., 1.		Tue., 2.	
			Motor.	Horse drawn.	Motor.	Horse drawn.
Springfield, Pawnee road	Olga Aarup	1	.....	.....	.....	.....
Springfield, Clear Lake road	Mrs. C. Colesar	2	.....	.....	.....	.....
Mt. Vernon, Fairfield road	Walter Warren	7	.....	.....	.....	.....
Peoria, Knoxville road	Mrs. C. W. McIntosh	8	.....	.....	.....	.....
Jerseyville, Fieldon road	M. Kirkpatrick	13	.....	.....	.....	.....
Sullivan, East road	Mrs. Sam T. Miller	14	.....	.....	.....	.....
Mt. Carmel, Maysville road	T. H. Kingsbury	15	.....	.....	.....	.....
Canton, South Main street	Leola Bucklew	16	.....	.....	.....	.....
McLean, Heyworth road	Mrs. H. L. VanNess	17	.....	.....	.....	.....
Salem, State road	Earl Estes	19	.....	.....	.....	.....
Carlinville, Chesterfield road	Edna A. Chiles	20	.....	.....	.....	.....
DeKalb, Malta road	Jos. Carroll	22	.....	.....	.....	.....
Dixon, Palmyra road	Mrs. W. H. Rupert	23	.....	.....	.....	.....
Rochelle, Rochelle avenue	Lida Holmblade	24	.....	.....	.....	.....
Freeport, North Galena road	Mrs. J. Schiller	25	.....	.....	.....	.....
Galva, South road	Ruby Lindquist	27	.....	.....	.....	.....
Champaign, Tolono road	J. Pancoast	29	.....	.....	.....	.....
Geneseo, Billy Wolf road	Wanda M. Wolf	31	.....	.....	.....	.....
New Lennox, Joliet road	O. C. Dickinson	32	.....	.....	.....	.....
Orland, East road	Henry Kott	33	.....	.....	.....	.....
Mendota	H. Weygand	34	.....	.....	.....	.....
Rock Island, Cemetery road	Paul J. Young	35	.....	.....	.....	.....
Springfield, Peoria road	Fred Brooks	36	.....	.....	.....	.....
Symerton, South Symerton road	Mrs. P. W. Walsh	37	.....	.....	.....	.....
Petersburg, East road	Anna Ortgessen	38	.....	.....	.....	.....
Nashville, St. Louis road	Mrs. Grace Gorman	40	.....	.....	.....	.....
Carmi, E. Main street	H. S. Parsons	42	.....	.....	.....	.....
East St. Louis, Falling Springs road	Florence Petterson	44	.....	.....	.....	.....
Vienna, Marion and Anna road	D. H. Ragain	46	.....	.....	.....	.....
Taylorville, North lane road	Clara Sharp	47	.....	.....	.....	.....
Marshall, National road	Mrs. M. M. Hedrick	50	.....	.....	.....	.....
Olney, Vincennes road	J. F. Hunt	51	.....	.....	.....	.....
Effingham, National road	Mrs. Mary Jakle	52	.....	.....	.....	.....
Salem, Salem-Vincennes road	Mrs. O. A. Sullivan	57	.....	.....	.....	.....
Greenville, Wisetown road	Ray VanDeusen	59	.....	.....	.....	.....
Beardstown, Chandlerville road	Mrs. L. Hammer	61	.....	.....	.....	.....
Rockford, State road	Mrs. J. L. McLain	62	.....	.....	.....	.....
Lincoln, Fair grounds road	Margaret Gluick	65	.....	.....	.....	.....
Streator, E. Main street	Mrs. W. H. Rowe	69	.....	.....	.....	.....
Rockford, Traskbridge road	J. F. Searles	71	.....	.....	.....	.....
Jerseyville, Fieldon road	Leora Snell	73	.....	.....	.....	.....
Morris	Mrs. Cad Ryder	75	.....	.....	.....	.....
Bement, Bement road	Mrs. J. F. Stoner	76	.....	.....	.....	.....
Rushville, State road	Mrs. Eph. Abbott	77	.....	.....	.....	.....
Springfield, County Club road	Mrs. Julia Murray	78	.....	.....	.....	.....
O'Fallon, Shiloh road	W. S. Scott	79	.....	.....	.....	.....
Bridgeport, Sumner road	Mrs. L. T. Lawson	80	.....	.....	.....	.....
Earlville	Mrs. Emily C. Taylor	81	.....	.....	.....	.....
Mt. Sterling, W. Cross street	E. E. Clark	83	.....	.....	.....	.....
Bloomington, Springfield road	Wm. H. Hardway	84	5	60	5	64
Wheaton, Geneva road	Mrs. A. H. Armbruster	85	.....	.....	.....	.....
Ashton, North road	Geo. Batchelor	86	.....	.....	.....	.....
Lombard, St. Charles road	M. P. Julius	87	.....	.....	.....	.....
Maple Park, Trans-Continental	Mrs. N. Klemm	88	.....	.....	.....	.....
Sterling, Morrison-Sterling	Mrs. Jno. Landherr	89	.....	.....	.....	.....
Geneva, Geneva-DeKalb	Ralph C. Shephard	90	.....	.....	.....	.....

NO. 28.

number of vehicles passing on dates given—1912.

January.

Wed., 3.		Thur., 4.		Fri., 5.		Sat., 6.		Sun., 7.		Mon., 8.		Tue., 9.	
Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.
4	61	.....	48	2	37	.....	58	.....	28	2	50	2	48

Table No. 28

Location of station.	Name of observer.	Station number.	January.			
			Wed., 10.		Thur., 11.	
			Motor.	Horse drawn.	Motor.	Horse drawn.
Springfield, Pawnee road	Ogla Aarup	1	.....	.....	.....	.....
Springfield, Clear Lake road	Mrs. C. Colesar	2	.....	.....	.....	.....
Mt. Vernon, Fairfield road	Walter Warren	7	.....	.....	.....	.....
Peoria, Knoxville road	Mrs. C. W. McIntosh	8	.....	.....	.....	.....
Jerseyville, Fieldon road	M. Kirkpatrick	13	.....	.....	.....	.....
Sullivan, East road	Mrs. Sam. T. Miller	14	.....	.....	.....	.....
Mt. Carmel, Maysville road	T. H. Kingsbury	15	.....	.....	.....	.....
Canton, South Main street	Leola Bucklew	16	.....	.....	.....	.....
McLean, Heyworth road	Mrs. H. L. VanNess	17	.....	.....	.....	.....
Salem, State road	Earl Estes	19	.....	.....	.....	.....
Carlinville, Chesterfield road	Edna A. Chiles	20	.....	.....	.....	.....
DeKalb, Malta road	Jos. Carroll	22	.....	.....	.....	.....
Dixon, Palmyra road	Mrs. W. H. Rupert	23	.....	.....	.....	.....
Rochelle, Rochelle avenue	Lida Holmblade	24	.....	.....	.....	.....
Freeport, North Galena road	Mrs. J. Schiller	25	.....	.....	.....	.....
Galva, South road	Ruby Lindquist	27	.....	.....	.....	.....
Champaign, Tolono road	J. Pancoast	29	.....	.....	.....	.....
Geneseo, Billy Wolf road	Wanda M. Wolf	31	.....	.....	.....	.....
New Lennox, Joliet road	O. C. Dickinson	32	.....	.....	.....	.....
Orland, East road	Henry Kott	33	.....	.....	.....	.....
Mendota	H. Weygand	34	.....	.....	.....	.....
Rock Island, Cemetery road	Paul J. Young	35	.....	.....	.....	.....
Springfield, Peoria road	Fred Brooks	36	.....	.....	.....	.....
Symerton, South Symerton road	Mrs. P. W. Walsh	37	.....	.....	.....	.....
Petersburg, East road	Anna Ortgessen	38	.....	.....	.....	.....
Nashville, St. Louis road	Mrs. Grace Gorman	40	.....	.....	.....	.....
Carmi, E. Main street	H. S. Parsons	42	.....	.....	.....	.....
East St. Louis, Falling Springs road	Florence Petterson	44	.....	.....	.....	.....
Vienna, Marion and Anna road	D. H. Ragain	46	.....	.....	.....	.....
Taylorville, North lane road	Clara Sharp	47	.....	.....	.....	.....
Marshall, National road	Mrs. M. M. Hedrick	50	.....	.....	.....	.....
Olney, Vincennes road	J. F. Hunt	51	.....	.....	.....	.....
Effingham, National road	Mrs. Mary Jakle	52	.....	.....	.....	.....
Salem, Salem-Vincennes road	Mrs. O. A Sullivan	57	.....	.....	.....	.....
Greenville, Wisetown road	Ray VanDeusen	59	.....	.....	.....	.....
Beardstown, Chandlerville road	Mrs. L. Hammer	61	.....	.....	.....	.....
Rockford, State road	Mrs. J. L. McLain	62	.....	.....	.....	.....
Lincoln, Fair grounds road	Margaret Gluick	65	.....	.....	.....	.....
Streator, E. Main street	Mrs. W. H. Rowe	69	.....	.....	.....	.....
Rockford, Traskbridge road	J. F. Searles	71	.....	.....	.....	.....
Jerseyville, Fieldon road	Leora Snell	73	.....	.....	.....	.....
Morris	Mrs. Cad Ryder	75	.....	.....	.....	.....
Bement, Bement road	Mrs. J. F. Stoner	76	.....	.....	.....	.....
Rushville, State road	Mrs. Eph. Abbott	77	.....	.....	.....	.....
Springfield, Country Club road	Mrs. Julis Murray	78	.....	.....	.....	.....
O'Fallon, Shiloh road	W. S. Scott	79	.....	.....	.....	.....
Bridgeport, Sumner road	Mrs. L. T. Lawson	80	.....	.....	.....	.....
Earlville	Mrs. Emily C. Taylor	81	.....	.....	.....	.....
Mt. Sterling, W. Cross street	E. E. Clark	83	.....	.....	.....	.....
Bloomington, Springfield road	Wm. H. Hardway	84	5	62	4	32
Wheaton, Geneva road	Mrs. A. H. Armbruster	85	.....	.....	.....	.....
Ashton, North road	George Batchelor	86	.....	.....	.....	.....
Lombard, St. Charles road	M. P. Julius	87	.....	.....	.....	.....
Maple Park, Trans-Continental	Mrs. N. Klemm	88	.....	.....	.....	.....
Sterling, Morrison-Sterling	Mrs. Jno. Landherr	89	.....	.....	.....	.....
Geneva, Geneva-DeKalb	Ralph C. Shephard	90	.....	.....	.....	.....

—Continued.

January.

Fri., 12.		Sat., 13.		Sun., 14.		Mon., 15.		Thur., 25.		Fri., 26.		Sat., 27.	
Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.
.....	.....	.....	.....	.....	.....	.....	.....	0	66	0	70	0	109
.....	.....	.....	.....	.....	.....	.....	.....	0	897	0	852	0	972
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	6	277	.....	232	2	216
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
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.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	19	285	18	284	19	269
.....	.....	.....	.....	.....	.....	.....	.....	0	82	0	80	0	72
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
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.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	1	232	1	314	0	316
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	4	206	4	191	8	216
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	2	108	2	196	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	9	439	16	375	17	431
.....	.....	.....	.....	.....	.....	.....	.....	0	172	0	179	0	198
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	0	29	0	50	0	50
.....	.....	.....	.....	.....	.....	.....	.....	0	102	0	132	0	105
.....	.....	.....	.....	.....	.....	.....	.....	11	365	8	312	5	289
.....	.....	.....	.....	.....	.....	.....	.....	.....	280	.....	305	.....	314
4	36	6	90	10	42	10	57	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
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Table No. 28

Location of station.	Name of observer.	Station number.	May.			
			Tue., 21.		Wed., 22.	
			Motor.	Horse drawn.	Motor.	Horse drawn.
Springfield, Pawnee road	Olga Aarup	1	.....	.....	.....	.....
Springfield, Clear Lake road	Mrs. C. Colesar	2	.....	.....	.....	.....
Mt. Vernon, Fairfield road	Walter Warren	7	.....	.....	.....	.....
Peoria, Knoxville road	Mrs. C. W. McIntosh	8	.....	.....	.....	.....
Jerseyville, Fieldon road	M. Kirkpatrick	13	.....	.....	.....	.....
Sullivan, East road	Mrs. Sam. T. Miller	14	.....	.....	.....	.....
Mt. Carmel, Maysville road	T. H. Kingsbury	15	.....	.....	.....	.....
Canton, South Main street	Leola Bucklew	16	.....	.....	.....	.....
McLean, Heyworth road	Mrs. H. L. VanNess	17	.....	.....	.....	.....
Salem, State road	Earl Estes	19	.....	.....	.....	.....
Carlinville, Chesterfield road	Edna A. Chiles	20	.....	.....	.....	.....
DeKalb, Malta road	Jos. Carroll	22	.....	.....	.....	.....
Dixon, Palmyra road	Mrs. W. H. Rupert	23	.....	.....	.....	.....
Rochelle, Rochelle avenue	Lida Holmblade	24	.....	.....	.....	.....
Freeport, North Galena road	Mrs. J. Schiller	25	.....	.....	.....	.....
Galva, South road	Ruby Lindquist	27	.....	.....	.....	.....
Champaign, Tolono road	J. Pancoast	29	.....	.....	.....	.....
Geneseo, Billy Wolf road	Wanda M. Wolf	31	.....	.....	.....	.....
New Lennox, Joliet road	O. C. Dickinson	32	.....	.....	.....	.....
Orland, East road	Henry Kott	33	.....	.....	.....	.....
Mendota	H. Weygand	34	.....	.....	.....	.....
Rock Island, Cemetery road	Paul J. Young	35	.....	.....	.....	.....
Springfield, Peoria road	Fred Brooks	36	.....	.....	.....	.....
Symerton, South Symerton road	Mrs. P. W. Walsh	37	.....	.....	.....	.....
Petersburg, East road	Anna Ortgessen	38	.....	.....	.....	.....
Nashville, St. Louis road	Mrs. Grace Gorman	40	.....	.....	.....	.....
Carmi, E. Main street	H. S. Parsons	42	.....	.....	.....	.....
East St. Louis, Falling Springs road	Florence Petterson	44	.....	.....	.....	.....
Vienna, Marion and Anna road	D. H. Ragain	46	.....	.....	.....	.....
Taylorville, North lane road	Clara Sharp	47	.....	.....	.....	.....
Marshall, National road	Mrs. M. M. Hedrick	50	.....	.....	.....	.....
Olney, Vincennes road	J. F. Hunt	51	.....	.....	.....	.....
Effingham, National road	Mrs. Mary Jakle	52	.....	.....	.....	.....
Salem, Salem-Vincennes road	Mrs. O. A. Sullivan	57	.....	.....	.....	.....
Greenville, Wisetown road	Ray VanDeusen	59	.....	.....	.....	.....
Beardstown, Chandlerville road	Mrs. L. Hammer	61	.....	.....	.....	.....
Rockford, State road	Mrs. J. L. McLain	62	.....	.....	.....	.....
Lincoln, Fair grounds road	Margaret Gluick	65	.....	.....	.....	.....
Streator, E. Main street	Mrs. W. H. Rowe	69	.....	.....	.....	.....
Rockford, Traskbridge road	J. F. Searles	71	.....	.....	.....	.....
Jerseyville, Fieldon road	Leora Snell	73	.....	.....	.....	.....
Morris	Mrs. Cad Ryder	75	.....	.....	.....	.....
Bement, Bement road	Mrs. J. F. Stoner	76	.....	.....	.....	.....
Rushville, State road	Mrs. Eph. Abbott	77	.....	.....	.....	.....
Springfield, Country Club road	Mrs. Julia Murray	78	.....	.....	.....	.....
O'Fallon, Shiloh road	W. S. Scott	79	.....	.....	.....	.....
Bridgeport, Sumner road	Mrs. L. T. Lawson	80	.....	.....	.....	.....
Earlville	Mrs. Emily C. Taylor	81	.....	.....	.....	.....
Mt. Sterling, W. Cross street	E. E. Clark	83	.....	.....	.....	.....
Bloomington, Springfield road	Wm. H. Hardway	84	.....	.....	.....	.....
Wheaton, Geneva road	Mrs. A. H. Armbruster	85	8	26	13	23
Ashton, North road	Geo. Batchelor	86	20	109	24	108
Lombard, St. Charles road	M. P. Julius	87	7	37	8	42
Maple Park, Trans-Continental	Mrs. N. Klemm	88	30	58	50	69
Sterling, Morrison-Sterling	Mrs. Jno. Landherr	89	10	31	9	36
Geneva, Geneva-DeKalb	Ralph C. Shephard	90	12	35	13	30

—Continued.

May.						June.									
Thur., 23.		Sat., 25.		Sun., 26.		Wed., 26.		Thur., 27.		Fri., 28.		Sat., 29.		Sun., 30.	
Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.
11	25	17	30	39	72	.....	.....	22	44	30	41	15	40	69	87
16	105	30	149	50	125	51	138	54	131	62	154	51	166	90	195
9	40	17	53	53	88	23	60	22	59	38	69	27	54	70	103
39	81	49	72	70	100	51	74	67	83	46	68	37	77	71	112
7	39	20	64	24	66	16	27	18	50	36	72	27	65	36	74
14	36	20	35	55	76	.....	.....	31	54	29	40	24	57	58	79

Table No. 28

Location of station.	Name of observer.	Station number.	July. Mon., 1. Motor.	July. Mon., 1. Horse drawn.	August. Fri., 30. Motor.	August. Fri., 30. Horse drawn.
Springfield, Pawnee road	Olga Aarup	1	.....	.....	.....	.....
Springfield, Clear Lake road	Mrs. C. Colesar	2	.....	.....	.....	.....
Mt. Vernon, Fairfield road	Walter Warren	7	.....	.....	.....	.....
Peoria, Knoxville road	Mrs. C. W. McIntosh	8	.....	.....	.....	.....
Jerseyville, Fieldon road	M. Kirkpatrick	13	.....	.....	.....	.....
Sullivan, East road	Mrs. Sam. T. Miller	14	.....	.....	.....	.....
Mt. Carmel, Maysville road	T. H. Kingsbury	15	.....	.....	.....	.....
Canton, South Main street	Leola Bucklew	16	.....	.....	.....	.....
McLean, Heyworth road	Mrs. H. L. VanNess	17	.....	.....	.....	.....
Salem, State road	Earl Estes	19	.....	.....	.....	.....
Carlinville, Chesterfield road	Edna A. Chiles	20	.....	.....	.....	.....
DeKalb, Malta road	Jos. Carroll	22	.....	.....	158	265
Dixon, Palmyra road	Mrs. W. H. Rupert	23	.....	.....	.....	.....
Rochelle, Rochelle avenue	Lida Holmblade	24	.....	.....	.....	.....
Freeport, North Galena road	Mrs. J. Schiller	25	.....	.....	.....	.....
Galva, South road	Ruby Lindquist	27	.....	.....	.....	.....
Champaign, Tolono road	J. Pancoast	29	.....	.....	.....	.....
Geneseo, Billy Wolf road	Wanda M. Wolf	31	.....	.....	.....	.....
New Lennox, Joliet road	O. C. Dickinson	32	.....	.....	.....	.....
Orland, East road	Henry Kott	33	.....	.....	.....	.....
Mendota	H. Weygand	34	.....	.....	.....	.....
Rock Island, Cemetery road	Paul J. Young	35	.....	.....	.....	.....
Springfield, Peoria road	Fred Brooks	36	.....	.....	.....	.....
Symerton, South Symerton road	Mrs. P. W. Walsh	37	.....	.....	.....	.....
Petersburg, East road	Anna Ortgessen	38	.....	.....	.....	.....
Nashville, St. Louis road	Mrs Grace Gorman	40	.....	.....	.....	.....
Carmi, E. Main street	H. S. Parsons	42	.....	.....	.....	.....
East St. Louis, Falling Springs road	Florence Petterson	44	.....	.....	.....	.....
Vienna, Marion and Anna road	D. H. Ragain	46	.....	.....	.....	.....
Taylorville, North lane road	Clara Sharp	47	.....	.....	.....	.....
Marshall, National road	Mrs. M. M. Hedrick	50	.....	.....	.....	.....
Olney, Vincennes road	J. F. Hunt	51	.....	.....	.....	.....
Effingham, National road	Mrs. Mary Jakle	52	.....	.....	.....	.....
Salem, Salem-Vincennes road	Mrs. O. A. Sullivan	57	.....	.....	.....	.....
Greenville, Wisetown road	Ray VanDeusen	59	.....	.....	.....	.....
Beardstown, Chandlerville road	Mrs. L. Hammer	61	.....	.....	.....	.....
Rockford, State road	Mrs. J. L. McLain	62	.....	.....	.....	.....
Lincoln, Fair grounds road	Margaret Glvick	65	.....	.....	.....	.....
Streator, E. Main street	Mrs. W. H. Rowe	69	.....	.....	.....	.....
Rockford, Traskbridge road	J. F. Searles	71	.....	.....	.....	.....
Jerseyville, Fieldon road	Leora Snell	73	.....	.....	.....	.....
Morris	Mrs. Cad Ryder	75	.....	.....	.....	.....
Bement, Bement road	Mrs. J. F. Stoner	76	.....	.....	.....	.....
Rushville, State road	Mrs. Eph. Abbott	77	.....	.....	.....	.....
Springfield, County Club road	Mrs. Julia Murray	78	.....	.....	.....	.....
O'Fallon, Shiloh road	W. S. Scott	79	.....	.....	.....	.....
Bridgeport, Sumner road	Mrs. L. T. Lawson	80	.....	.....	.....	.....
Earlville	Mrs. Emily C. Taylor	81	.....	.....	.....	.....
Mt. Sterling, W. Cross street	E. E. Clark	83	.....	.....	.....	.....
Bloomington, Springfield road	Wm. H. Hardway	84	.....	.....	.....	.....
Wheaton, Geneva road	Mrs. A. H. Armbruster	85	24	37	.....	.....
Ashton, North road	Geo. Batchelor	86	.....	.....	30	167
Lombard, St. Charles road	M. P. Julius	87	.....	.....	54	87
Maple Park, Trans-Continental	Mrs. N. Klemm	88	.....	.....	78	115
Sterling, Morrison-Sterling	Mrs. Jno. Landherr	89	.....	.....	11	91
Geneva, Geneva-DeKalb	Ralph C. Shephard	90	.....	.....	33	60

—Continued.

August.		September.									
Sat., 31.		Sun., 1.		Mon., 2.		Tue., 3.		Wed., 4.		Thur., 26.	
Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0	135
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0	906
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0	332
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	41	257
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	28	188
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	64	264
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	15	223
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	28	326
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	21	141
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	321
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	16	101
200	406	207	316	239	408	93	241	.....	.....	.....	.....
85	385	169	247	160	385	102	384	68	353	110	338
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	93	396
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	27	121
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	111	242
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	23	135
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	9	56
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5	229
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	45	173
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	117	438
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	34	134
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	111
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	29	196
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	51
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	60	555
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10	75
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	160
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	42	202
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	15	339
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	159
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10	258
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	84
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	24	112
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	23	119
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	37	398
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	72	303
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	293
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	33	247
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	44	202
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	29	274
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	11	35
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0	72
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0	130
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	42	263
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	38	416
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	116	232
92	114	75	91	58	74	22	37	21	43	.....	.....
60	155	116	195	76	185	46	155	.....	.....	29	106
143	180	70	116	76	109	24	60	.....	.....	16	50
78	111	94	129	83	109	56	100	.....	.....	47	91
33	93	49	76	37	122	34	119	.....	.....	8	37
53	87	61	85	40	64	28	65	.....	.....	29	64

Table No. 28

Location of station.	Name of observer.	Station number.	September.			
			Fri., 27.		Sat., 28.	
			Motor.	Horse drawn.	Motor.	Horse drawn.
Springfield, Pawnee road	Olga Aarup	1	0	277	0	219
Springfield, Clear Lake road	Mrs. C. Colesar	2	0	860	0	1,181
Mt. Vernon, Fairfield road	Walter Warren	7	0	404	0	520
Peoria, Knoxville road	Mrs. C. W. McIntosh	8	22	134	21	183
Jerseyville, Fieldon road	M. Kirkpatrick	13	27	154	40	201
Sullivan, East road	Mrs. Sam. T. Miller	14	42	244	70	351
Mt. Carmel, Maysville road	T. H. Kingsbury	15	37	313	20	387
Canton, South Main street	Leola Bucklew	16	55	373	7	248
McLean, Heyworth road	Mrs. H. L. VanNess	17	29	175	38	231
Salem, State road	Earl Estes	19	12	174	21	268
Carlinville, Chesterfield road	Edna A. Chiles	20	10	134	42	254
DeKalb, Malta road	Jos. Carroll	22	.....	.....	.....	.....
Dixon, Palmyra road	Mrs. W. H. Rupert	23	46	369	.....	.....
Rochelle, Rochelle avenue	Lida Holmblade	24	120	535	71	375
Freeport, North Galena road	Mrs. J. Schiller	26	95	336	1	222
Galva, South road	Ruby Lindquist	27	30	197	4	111
Champaign, Tolono road	J. Pancoast	29	95	194	331	331
Geneseo, Billy Wolf road	Wanda M. Wolf	31	30	141	17	171
New Lennox, Joliet road	O. C. Dickinson	32	19	70	16	47
Orland, East road	Henry Kott	33	19	238	8	170
Mendota	H. Weygand	34	52	207	32	183
Rock Island, Cemetery road	Paul J. Young	35	152	549	51	354
Springfield, Peoria road	Fred Brooks	36	27	116	40	130
Symerton, South Symerton road	Mrs P. W. Walsh	37	16	139	8	134
Petersburg, East road	Anna Ortgessen	38	29	180	36	305
Nashville, St. Louis road	Mrs. Grace Gorman	40	5	47	14	64
Carmi, E. Main street	H. S. Parsons	42	59	550	55	447
East St. Louis, Falling Springs road	Florence Petterson	44	11	50	9	60
Vienna, Marion and Anna road	D. H. Ragain	46	.....	82	2	128
Taylorville, North lane road	Clara Sharp	47	32	173	44	297
Marshall, National road	Mrs. M. M. Hedrick	50	46	498	42	736
Olney, Vincennes road	J. F. Hunt	51	10	175	41	295
Effingham, National road	Mrs. Mary Jakle	52	13	291	26	281
Salem, Salem-Vincennes road	Mrs. O. A. Sullivan	57	1	50	.....	58
Greenville, Wisetown road	Ray VanDeusen	59	.....	.....	.....	.....
Beardstown, Chandlerville road	Mrs. L. Hammer	61	24	124	20	166
Rockford, State road	Mrs. J. L. McLain	62	50	149	.....	62
Lincoln, Fair grounds road	Margaret Gluick	65	13	209	21	231
Streator, E. Main street	Mrs. W. H. Rowe	69	48	274	67	346
Rockford, Traskbridge road	J. F. Searles	71	0	357	0	352
Jerseyville, Fieldon road	Leora Snell	73	25	279	44	228
Morris	Mrs. Cad Ryder	75	.....	.....	.....	.....
Bement, Bement road	Mrs. J. F. Stoner	76	28	170	26	211
Rushville, State road	Mrs. Eph. Abbott	77	30	280	20	316
Springfield, Country Club road	Mrs. Julia Murray	78	27	13	0	151
O'Fallon, Shiloh road	W. S. Scott	79	7	81	22	83
Bridgeport, Sumner road	Mrs. L. T. Lawson	80	8	197	11	252
Earlville	Mrs. Emily C. Taylor	81	59	315	74	342
Mt. Sterling, W. Cross street	E. E. Clark	83	57	434	59	555
Bloomington, Springfield road	Wm. H. Hardway	84	113	245	152	297
Wheaton, Geneva road	Mrs. A. H. Armbruster	85	10	21	13	34
Ashton, North road	Geo. Batchelor	86	30	148	14	109
Lombard, St. Charles road	M. P. Julius	87	20	65	12	43
Maple Park, Trans-Continental	Mrs. N. Klemm	88	40	77	32	75
Sterling, Morrison-Sterling	Mrs. Jno. Landherr	89	18	48	5	36
Geneva, Geneva-DeKalb	Ralph C. Shephard	90	30	64	16	49

—Concluded.

September.				October.							
Sun., 29.		Mon., 30.		Tue., 1.		Wed., 2.		Thur., 3.		Fri., 4.	
Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.	Motor.	Horse drawn.
0	127	0	176	.....	.....	.....	.....	.....	.....	.....	.....
0	592	0	927	.....	.....	.....	.....	.....	.....	.....	.....
0	153	0	239	.....	.....	.....	.....	.....	.....	.....	.....
77	164	30	167	.....	.....	.....	.....	.....	.....	.....	.....
64	129	39	139	.....	.....	.....	.....	.....	.....	.....	.....
104	237	59	250	.....	.....	.....	.....	.....	.....	.....	.....
39	206	19	195	.....	.....	.....	.....	.....	.....	.....	.....
42	181	36	270	.....	.....	.....	.....	.....	.....	.....	.....
74	213	35	159	.....	.....	.....	.....	.....	.....	.....	.....
33	119	28	270	.....	.....	.....	.....	.....	.....	.....	.....
84	327	22	249	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
197	393	82	363	91	377	.....	.....	.....	.....	.....	.....
138	341	102	343	97	355	.....	.....	.....	.....	.....	.....
73	324	71	393	.....	.....	.....	.....	.....	.....	.....	.....
62	168	18	137	.....	.....	.....	.....	.....	.....	.....	.....
201	324	252	504	.....	.....	.....	.....	.....	.....	.....	.....
52	188	23	146	.....	.....	.....	.....	.....	.....	.....	.....
37	75	7	48	.....	.....	.....	.....	.....	.....	.....	.....
7	217	.....	214	.....	.....	.....	.....	.....	.....	.....	.....
44	186	39	168	.....	.....	.....	.....	.....	.....	.....	.....
211	454	112	417	.....	.....	.....	.....	.....	.....	.....	.....
31	92	29	108	.....	.....	.....	.....	.....	.....	.....	.....
15	128	13	196	.....	.....	.....	.....	.....	.....	.....	.....
41	193	34	162	.....	.....	.....	.....	.....	.....	.....	.....
14	50	5	64	.....	.....	.....	.....	.....	.....	.....	.....
99	317	112	615	.....	.....	.....	.....	.....	.....	.....	.....
28	80	2	71	.....	.....	.....	.....	.....	.....	.....	.....
3	37	.....	92	.....	.....	.....	.....	.....	.....	.....	.....
54	189	23	207	.....	.....	.....	.....	.....	.....	.....	.....
50	298	35	231	.....	.....	.....	.....	.....	.....	.....	.....
72	143	19	152	.....	.....	.....	.....	.....	.....	.....	.....
24	207	14	290	.....	.....	.....	.....	.....	.....	.....	.....
5	46	6	77	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
51	170	13	109	.....	.....	.....	.....	.....	.....	.....	.....
101	243	20	129	.....	.....	.....	.....	.....	.....	.....	.....
25	158	25	239	.....	.....	.....	.....	.....	.....	.....	.....
95	194	89	350	.....	.....	.....	.....	.....	.....	.....	.....
0	258	0	365	.....	.....	.....	.....	.....	.....	.....	.....
55	133	43	184	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	132	598	128	510	138	409	43	304	84	485
59	206	41	248	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	22	223	24	242	.....	.....	.....	.....	.....	.....
120	241	62	186	.....	.....	.....	.....	.....	.....	.....	.....
72	144	12	77	.....	.....	.....	.....	.....	.....	.....	.....
12	207	17	322	.....	.....	.....	.....	.....	.....	.....	.....
28	276	109	359	.....	.....	.....	.....	.....	.....	.....	.....
81	216	38	514	.....	.....	.....	.....	.....	.....	.....	.....
337	471	101	198	.....	.....	.....	.....	.....	.....	.....	.....
25	62	9	30	13	35	.....	.....	.....	.....	.....	.....
49	147	34	134	.....	.....	.....	.....	.....	.....	.....	.....
36	77	18	49	.....	.....	.....	.....	.....	.....	.....	.....
105	146	38	63	.....	.....	.....	.....	.....	.....	.....	.....
31	58	9	28	.....	.....	.....	.....	.....	.....	.....	.....
40	81	32	66	.....	.....	.....	.....	.....	.....	.....	.....

BRIDGE WORK.

The demand for the inspection and supervision of highway bridges has steadily increased during 1910, 1911 and 1912. The boards of supervisors of a number of additional counties have officially recognized the work of the commission in connection with bridge work by the passage of resolutions restricting county aid to structures for which the commission has prepared plans and specifications.

A bridge bulletin (No. 9) has been published in which is given a concise outline of the services rendered by the commission in connection with bridge work, and in which is given detailed instructions in regard to the preliminary application and subsequent steps necessary to be observed by local officials while the work is under way, and to the time of final payment and acceptance of the structure. The bulletin contains many illustrations of steel and concrete bridges. Copies of this bulletin may be obtained upon written application to the Illinois Highway Commission, Springfield, Ill.

Although in previous reports and bridge bulletins local officials have been strongly urged to arrange for bridge work during the fall and early winter months, so that contracts may be let during the early winter for the next season's construction, yet the great bulk of the bridge work is not taken up until May, June or July. This results in a shorter construction season, higher prices, and numerous incompleted bridges when cold weather sets in. This matter is of such great importance that the paragraphs relating to this subject contained in the 1908-1909 report of the commission are here repeated:

"Applications for bridge work are received in greatest number during the months of May, June and July. A greater economy can be secured, not only in the construction of bridges, but also in the work of the commission if arrangements can be made to have applications for bridge work come to the commission in the late fall and early winter. More favorable prices can be obtained by letting contracts for steel bridges late in the fall for construction the following season as the shops of the bridge companies are then provided with work for the winter months, when the general demand for structural steel work is not great. Somewhat better prices can also be obtained on concrete bridge work if contracts are let during the winter months. A contractor is not always able to provide employment for his construction foreman

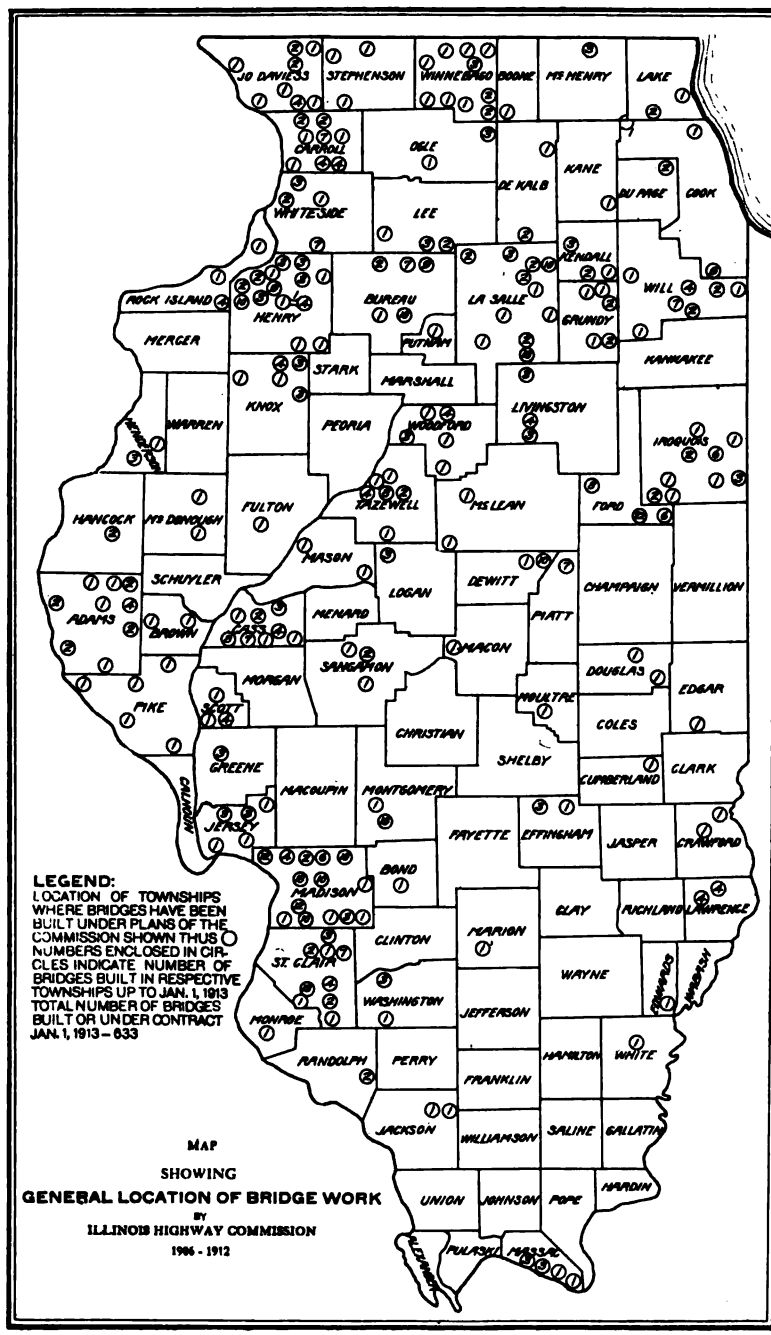

JO DAVIESS
STEPHENSON
WINNEBAGO
BOONE
MC HENRY
LAKE
CARROLL
OGLE
KANE
DE KALB
DU PAGE
COOK
WHITESIDE
LEE
KENDALL
WILL
ROCK ISLAND
HENRY
BUREAU
LA SALLE
GRUNDY
MERCER
PUTNAM
KANKAKEE
STARK
MARSHALL
KNOX
PEORIA
LIVINGSTON
WOODFORD
WARREN
IROQUOIS
HANCOCK
MC DONOUGH
FULTON
TAZEWELL
MC LEAN
FORD
MASON
SCHUYLER
LOGAN
DEWITT
CHAMPAIGN
VERMILLION
ADAMS
BROWN
CASS
MENARD
PIATT
MACON
SANGAMON
DOUGLAS
EDGAR
MORGAN
PIKE
SCOTT
MOULTRIE
COLES
CHRISTIAN
SHELBY
GREENE
CUMBERLAND
CLARK
CALHOUN
MACOUPIN
MONTGOMERY
JERSEY
FAYETTE
EFFINGHAM
JASPER
CRAWFORD
BOND
MADISON
CLAY
RICHLAND
LAWRENCE
CLINTON
MARION
ST. CLAIR
WAYNE
WABASH
EDWARDS
WASHINGTON
JEFFERSON
MONROE
RANDOLPH
PERRY
HAMILTON
WHITE
FRANKLIN
JACKSON
WILLIAMSON
SALINE
GALLATIN
UNION
JOHNSON
POPE
HARDIN
ALEXANDER
PULASKI
MASSAC
LEGEND:
LOCATION OF TOWNSHIPS WHERE BRIDGES HAVE BEEN BUILT UNDER PLANS OF THE COMMISSION SHOWN THUS ○ NUMBERS ENCLOSED IN CIRCLES INDICATE NUMBER OF BRIDGES BUILT IN RESPECTIVE TOWNSHIPS UP TO JAN. 1, 1913 TOTAL NUMBER OF BRIDGES BUILT OR UNDER CONTRACT JAN. 1, 1913 – 633
MAP
SHOWING
GENERAL LOCATION OF BRIDGE WORK
BY
ILLINOIS HIGHWAY COMMISSION
1906 - 1912

FIG. 13.

during the winter months which is profitable alike to himself and the foreman. He therefore, generally finds it desirable to figure close on work that he can start as early in the spring as construction work can be carried on safely, so that he can keep his old foreman, on whom he can rely, from going to a rival who might have contracts for early spring work.

"The experience of the State Highway Commission has proven that competition is much closer on contracts let in the winter with plenty of time allowed for completing the work the following season than when contracts are let during the spring and summer with no more than a reasonable amount of time allowed for completing the work.

"From the point of view of the State Highway Commission, if applications are received during the fall and winter, they may be handled much more expeditiously, as some of the engineers who are employed on construction work during the summer months are available to handle the preparation of the plans and specifications.

"Local officials having bridge work in charge can, by making a careful study, determine in the fall or winter the structures which it will be necessary to replace or repair the following season. If this is done, the inspection made, plans and specifications prepared, and the contract let early in the winter, the results will be better prices and the bridges will be completed before traction engines and crops are moving over the highways the next season. When contracts are let in the spring or summer, unforeseen circumstances often arise causing delay in the completion of the structures perhaps when they are most needed. Not infrequently concrete work is held up by cold weather and completion delayed until the following season."

The adaptability of the flat slab and girder type of reinforced concrete bridge to Illinois conditions is becoming more and more evident. For spans up to 60 feet in length, a single span reinforced concrete bridge is rarely more costly than a well designed steel bridge on concrete abutments and it has the advantage of being practically permanent with no expense for maintenance.

Plate No. 21 illustrates the result of lack of proper attention to maintenance in case of a steel bridge. The inclined steel post here shown has been entirely rusted through. Steel bridges should, at all times, be protected from rust by keeping all steel work thoroughly painted. Only the best of linseed oil paint should be used and the steel should be thoroughly cleaned of all rust, dirt or other foreign material before the paint is applied. If the cleaning is not most thoroughly done, the application of paint will be of little value.

The rusting of steel bridges is particularly noticeable near cities because of coal smoke fumes and in southern Illinois where the soil is frequently acid. The acid found in southern Illinois soil rapidly attacks bridge steel, frequently causing the almost complete destruction of a plate of steel three-sixteenths of an inch in thickness in ten or twelve years. This dangerous condition does not obtain with concrete structures.

The adaptability of reinforced concrete to longer spans where a series of spans may be used, is well illustrated by the Sulphur Spring bridge shown on Plate No. 38. For this crossing, a 150-foot span concrete floor steel bridge, with reinforced concrete abutments was designed and also a reinforced concrete bridge consisting of three 50-foot clear spans. Bids were received on each set of plans. The lowest bid on the steel structure was $5,800.00, and on the reinforced concrete structure, $5,989.00, a difference of only $189.00. As one additional coat of paint on the steel bridge would cost about as much as this difference, it is evident that the concrete bridge is by far the more economical.

A general summary of all the bridge work handled by the State Highway Commission is given in the following table:

TABLE NO. 29.

Summary of bridge work to January 1, 1913.

Year.	Inspections made.	Plans and specifications prepared.	Contracts let.*	Steel bridges completed.	Concrete bridges completed.	Cost of bridges constructed.
1906.....	26	15	11	0	2	$ 37,035 00
1907.....	156	113	48	7	32	41,519 00
1908.....	198	149	64	17	46	165,674 00
1909.....	135	122	92	20	57	133,285 00
1910.....	231	203	141	17	91	148,432 00
1911.....	300	241	127	26	132	238,903 00
1912.....	287	214	150	†13	†173	212,694 00
Total.....	1,333	1,057	633	100	533	$977,542 00

* Includes force account bridges placed under construction.
† Includes bridges under contract Jan. 1, 1913, as well as bridges completed during 1912.

SPECIAL FEATURES OF BRIDGE DESIGN.

During the period covered by this report, several new features of bridge design have been developed.

In the design of steel superstructures, the usual methods of finding stresses and proportioning members of trusses, have been used, with the exception of allowance for impact, which has been omitted entirely in the design of concrete floor steel bridges.

To determine the actual effect of impact on highway bridges a series of tests were arranged. Various methods of loading were tried on concrete floor steel bridges and impact measured with delicate instruments. The details of the tests will not be repeated here. The conclusions reached are as follows:

The usual specified loading for ordinary country highway bridges of 100 pounds per square foot of roadway surface is rarely, if ever, realized over any considerable portion of the roadway surface. The only practical method found to obtain such load even by special arrangement for test purposes, was by means of a series of special eight-ton stone wagons hauled by a traction engine. As two cars are usually the maximum load which may be hauled by one tractor over the ordinary

The Old Wilson street east bridge over Fox River, city of Batavia, Kane County.

This old structure which was too narrow and had become badly damaged, was replaced by a new reinforced concrete bridge shown on the next plate.

country road, the length of the bridge covered by such a load is limited to 40 or 50 feet. No measurable impact stresses were produced by this maximum load on concrete floor steel bridges.

A traction engine weighing as much as fifteen tons may be a comparatively frequent highway load and should be provided for in the design of the floor system of all bridges.

Traction engines weighing as much as 20 tons are sometimes encountered and should be provided for in the design of floor systems. As such loads are comparatively rare, however, a greater unit stress may be allowed in proportioning the floor system for such loads. No appreciable impact stress was found in any of the members of a concrete floor steel bridge for traction engine loads.

For short span bridges a traction engine followed by a separator may produce maximum stresses in truss members.

A single horse trotting in time with the vibration period of a bridge may produce impact stresses amounting to several times the static load stress, but the greatest stress so found is far below the stress provided by the ordinary conventional loads assumed in designing.

On account of the expense of maintaining wood floors, the Illinois Highway Commission designs all steel bridges with concrete floors covered by a wearing surface of gravel or macadam.

It is probable that in the near future, one of the heaviest loads to be borne by bridges on the main highways will be the motor truck, but it does not appear that these loads will exceed the traction engine loads already mentioned.

In the design of reinforced concrete superstructures, the unit stress allowed in the steel for slab bridges for dead and live loads is 12,000 pounds. This low unit stress is provided so that contraction of the superstructure in cold weather will not produce undue stress in the steel.

The abutments for slab bridges are usually low and comparatively rigid, and as it has been found impractical to provide sliding of the superstructure over the abutments, it has been found more economical for slab bridges to provide sufficient steel to take care of the combined dead load, live load and temperature stresses than to provide a more or less complicated and expensive expansion joint of low friction.

In the design of reinforced concrete girder bridges, however, it has been found more economical to provide for expansion at one end of the bridge than to use sufficient reinforcing steel to take care of the temperature stress in addition to the dead load and live load stresses. The use of an expansion device of low friction justifies the use of a higher dead and live load unit stress in the steel. This is of considerable importance particularly for long span reinforced concrete girders where the space available for packing the girder steel is limited.

Two methods of providing for expansion in girder bridges have been used and both have proved satisfactory. In one method, the wing walls of one abutment are entirely separated from the abutment wall proper, the latter being free to move at the top with the expansion or

contraction of the superstructure. The wing walls are designed to be self-supporting. As girder spans designed by the commission have so far been limited to 60 feet, the amount of movement either way from the normal is small and is taken up by deflection of the main wall or a slight rocking of the wall on the footing. Earth pressure against the wall is of little importance in this connection as it but tends to reduce the tension in the girder steel during expansion and to cause the abutment wall to follow the superstructure during contraction. It does not increase the stress in the compression area of the girder as the load is applied at the bottom of the girder tending by this eccentricity of application to reverse the dead and live load stresses in the girder.

This method has been found to be entirely successful, but is somewhat objectionable as a slight movement of the wings due to earth pressure and unequal settlement sometimes causes the wing walls to move forward slightly at the top, making a somewhat unsightly off-set between the wing and abutment walls. This has never been more than 2 or 3 inches for the highest walls, but as it is not understood by the ordinary observer, an impression of weakness is sometimes caused.

The present method of providing for expansion is to design the abutments and wings in the ordinary way, separating the superstructure completely from one of the abutments by a thick paper joint and supporting each girder at the free end on a single cast iron rocker of large diameter. The reaction is transmitted to the girder and abutment from the rocker through planed structural steel plates stiffened with I beams when necessary. The rocker surfaces in contact with the bearing plates are turned to insure perfect bearing on the plates. The diameter of the rocker is made proportional to the load imposed per lineal inch, in the same manner as is commonly used in proportioning roller nests for steel bridges. The upper and lower plates are bedded in the concrete of the superstructure and abutment. The rocker is located in a pocket built in the abutment. This pocket is filled with a soft asphalt to prevent the entrance of water or dirt and to protect the metal from corrosion.

The rocker method of providing for expansion has proved very satisfactory, and is but little more expensive than the other method, especially when it is considered that the wings may be tied to the main wall when rockers are used, and advantage taken of the mutual support thus obtained. Figure No. 19 shows how the rockers are arranged at the free end of the girders.

Reinforced concrete abutments for steel bridges have proved to be economical when the height of abutment is 16 feet or more. Whether plain or reinforced concrete for abutments is the cheaper, depends, however, upon the cost of concrete materials at the bridge site as well as upon the height of the abutments.

The cantilever principle, as illustrated in Fig. 14 and plate No. 24 is now used for reinforced abutments for steel bridges in preference to the buttressed or counterfort type. For heights at least 25 or 30 feet, the additional concrete and reinforcing steel required for the cantilever

type of reinforced concrete abutment is more than compensated by the simplicity of the form work and the arrangement of the reinforcement. The cost of the forms for the cantilever type is but slightly more than

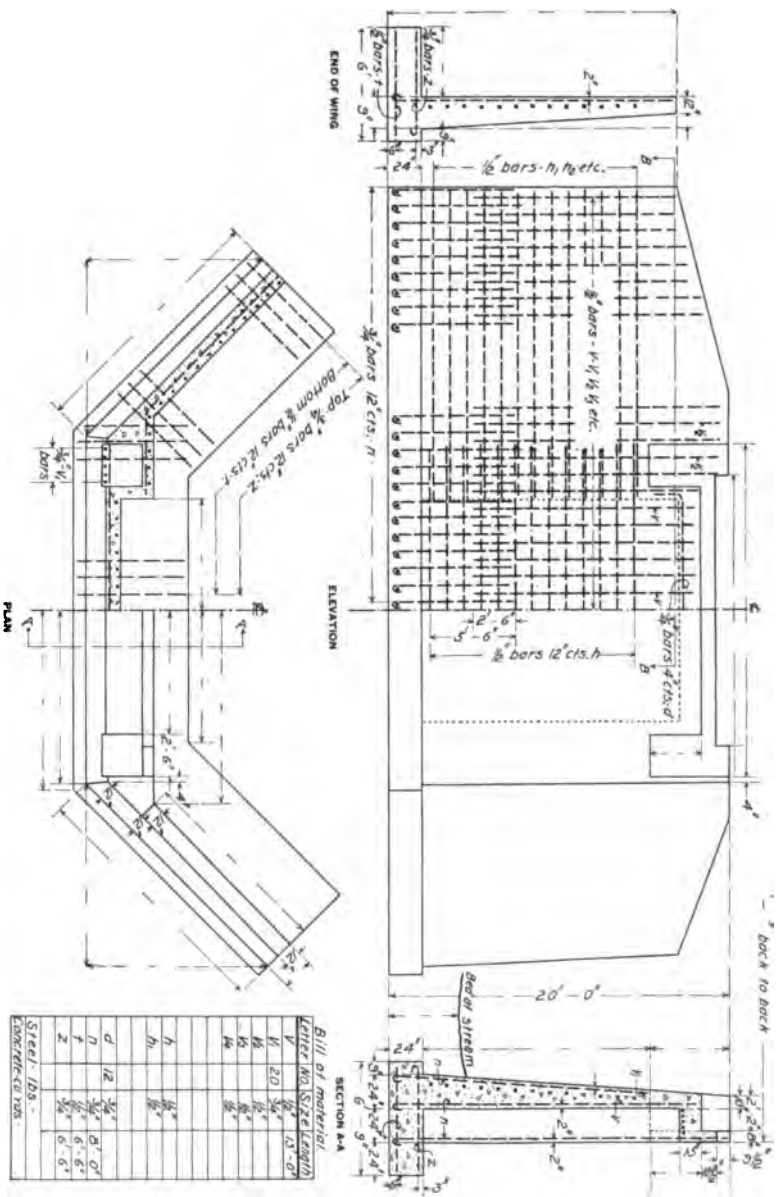


Fig. 14. Type of reinforced concrete abutment used for steel bridges. Cantilever principle used throughout.

for plain concrete abutments of the same height, while the forms for the buttressed type of abutment are complicated and much more expensive. The lumber used for the cantilever type has a distinct salvage

value, while that for the counterfort type is so badly cut that it has practically no salvage value. More steel is required for the cantilever type but as little bending is required, the total bill of steel can be

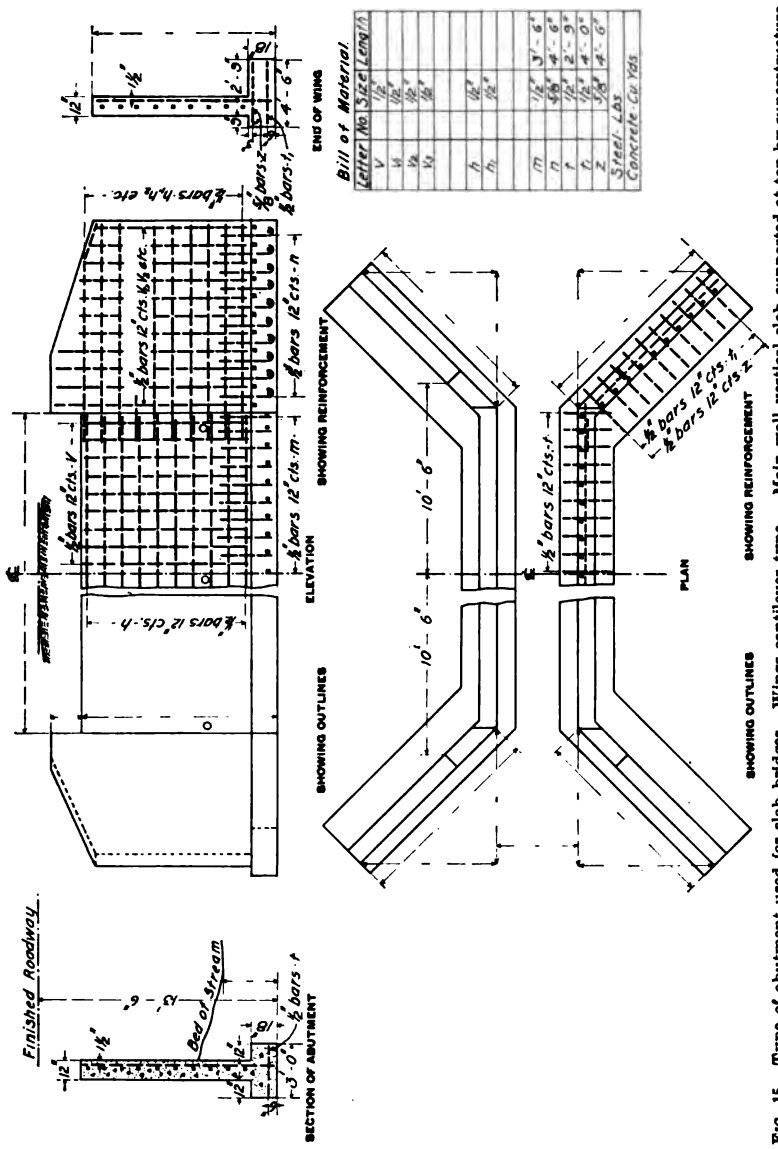


FIG. 15. Type of abutment used for slab bridges. Wings cantilever type. Main wall vertical slab supported at top by superstructure and at base by footing.

placed at less expense than in the counterfort type where the bends must be numerous and more or less complicated. On account of the comparative simplicity, better workmanship and more accurate location of the steel is secured.

In the design of reinforced concrete abutments for both steel and concrete bridges, the following general method of design is observed: When local conditions require the wing walls to be built at an angle less than 45 degrees with the face of the abutment, both the main

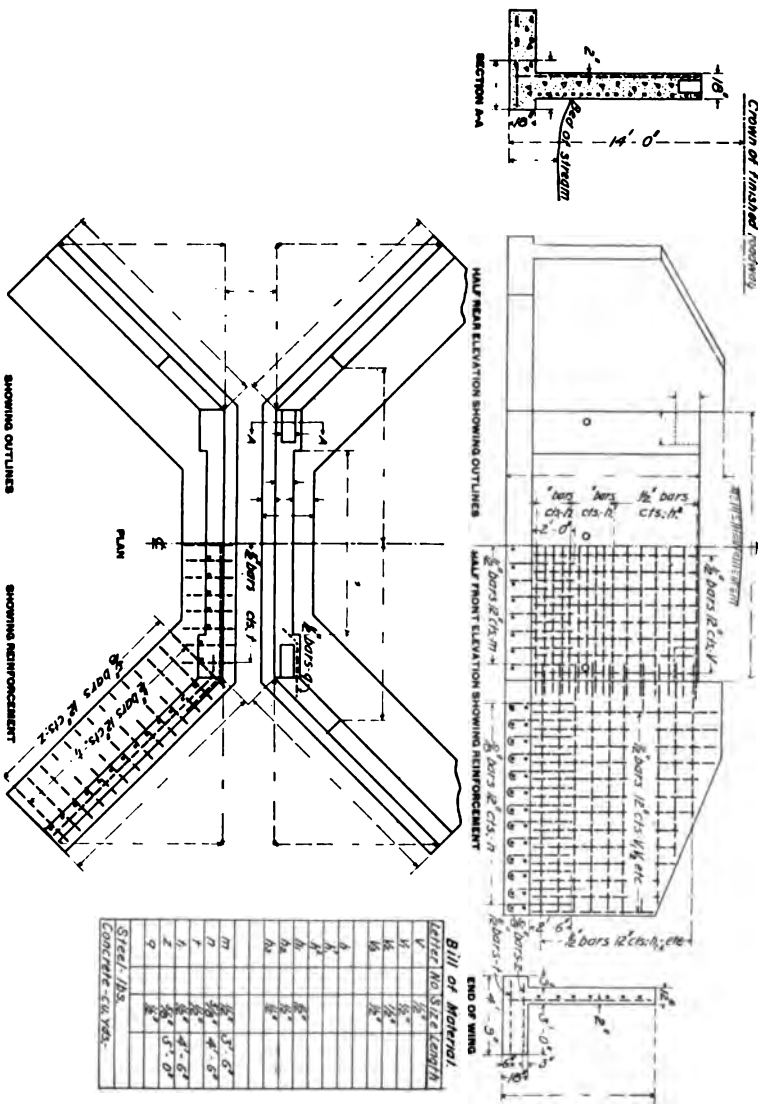


Fig. 16.—Type of abutment used for reinforced concrete, girder bridges. Wings cantilever type. Main wall supported by wings as counterforts.

wall and wing walls are designed as self-supporting retaining walls of the cantilever type except the main wall for slab bridges. The main wall of slab bridges is designed as a vertical slab, supported at the top by the superstructure and at the bottom by the footing. The reinforce-

ment in the main wall of slab bridges is therefore vertical and near the stream side of the wall, while in the main wall of abutments for steel and girder bridges, the steel is also vertical but placed near the back face of the wall.

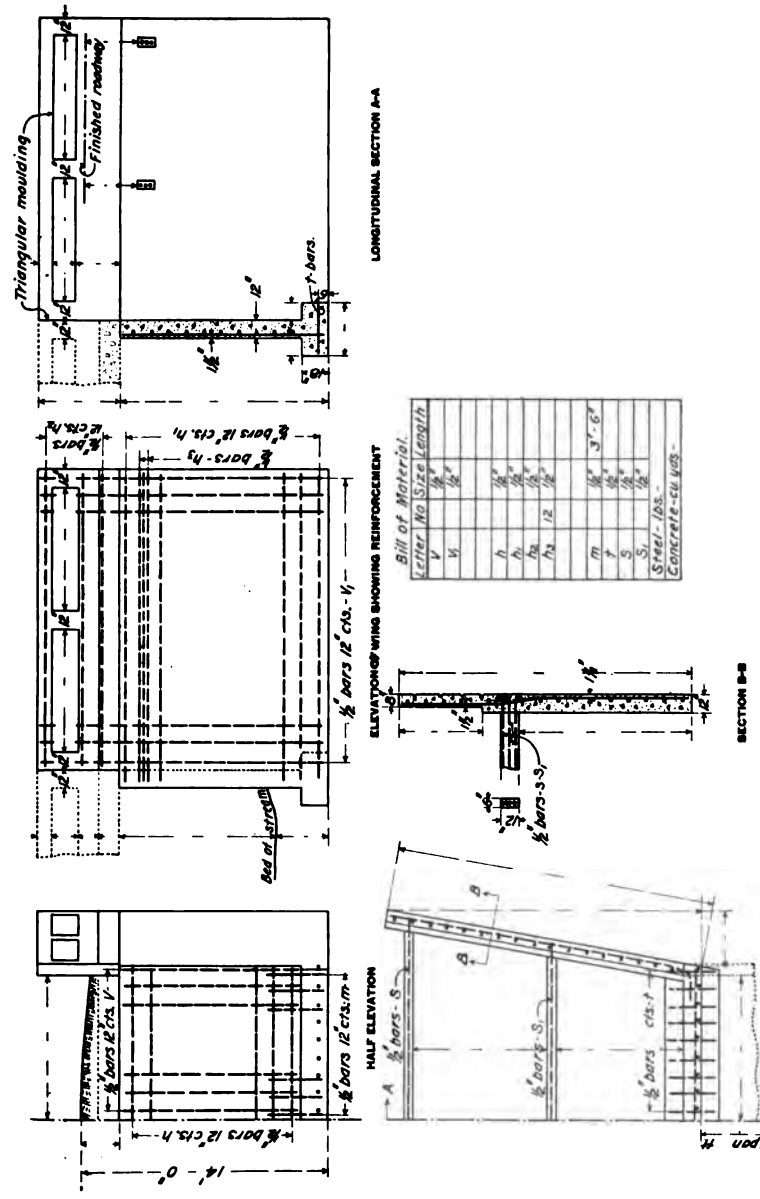
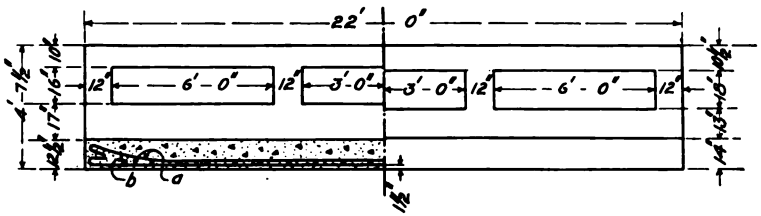
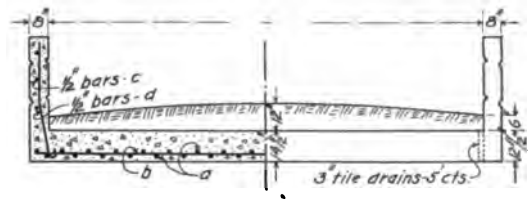
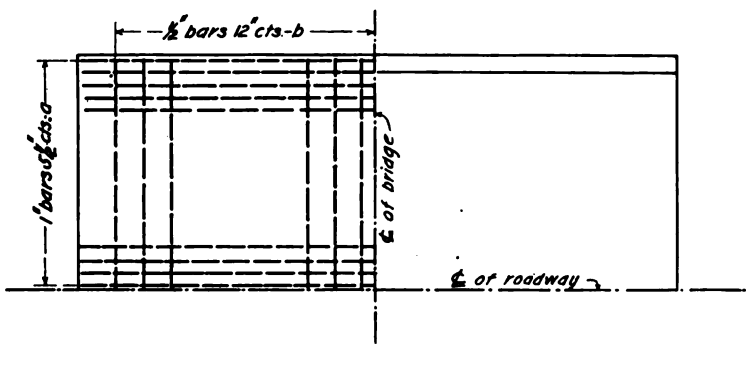


FIG. 17. Type of abutment used for slab bridges. Wings are vertical slabs restrained at top by ties across the roadway and at base by earth resistance. Main wall supported at top and bottom by superstructure and footing respectively.



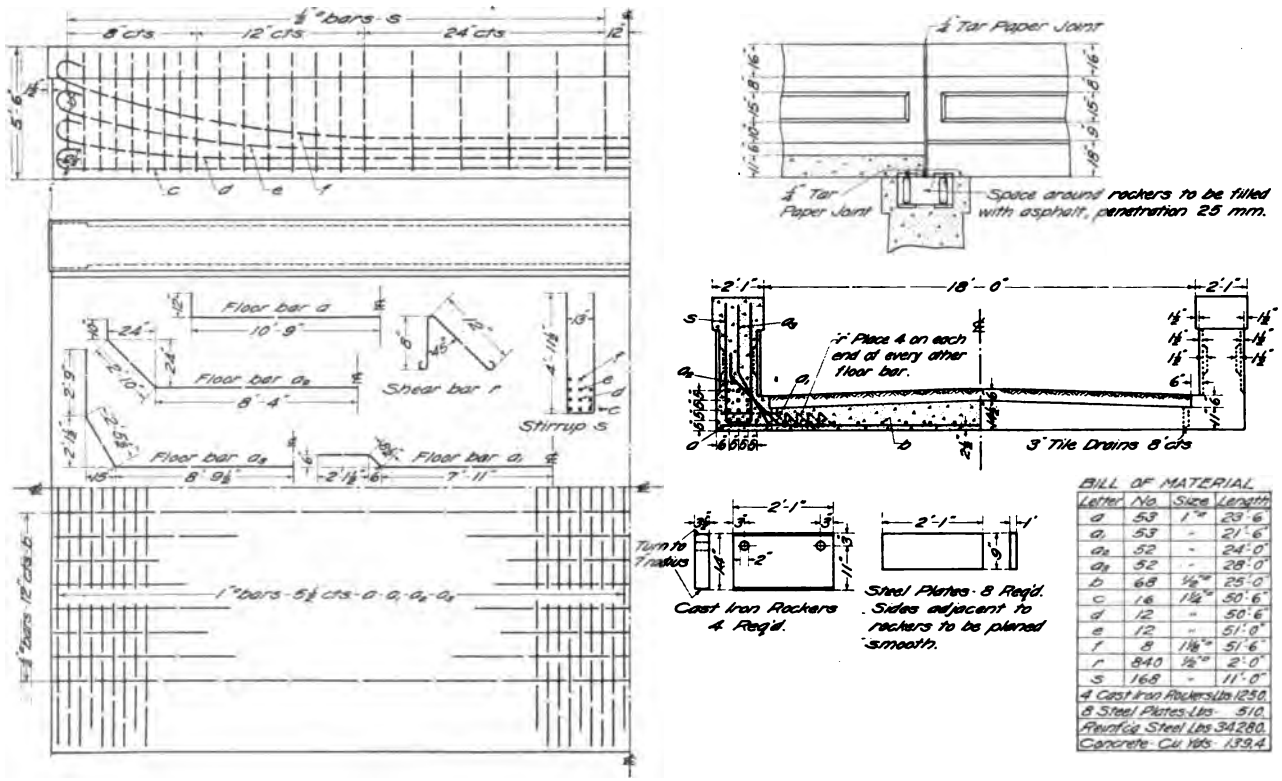




Bill of Material.

Letter	No.	Size	Length
a		1"	25'-0"
b	20	½"	
c	6	½"	21'-8"
d	40	½"	4'-8"
Steel-lbs.			
Concrete-cu yds.			

FIG. 13.—Typical reinforced concrete slab superstructure.


8 cts
12 cts
24 cts
Floor bar a
Floor bar a2
Floor bar a3
Floor bar a1
Shear bar r
Stirrup s
1" bars 5½ cts a a1 a2 a3
Tar Paper Joint
Space around rockers to be filled with asphalt, penetration 25 mm.
Place 4 on each end of every other floor bar.
3" Tile Drains 8' cts
Turn to 7" radius
Cast Iron Rockers 4 Req'd.
Steel Plates 8 Req'd. Sides adjacent to rockers to be planed smooth.

BILL OF MATERIAL

Letter	No.	Size	Length
a	53	1"	23'6"
a1	53	-	21'6"
a2	52	-	24'0"
a3	52	-	28'0"
b	68	½"	25'0"
c	16	1¼"	50'6"
d	12	-	50'6"
e	12	-	51'0"
f	8	1⅛"	51'6"
r	840	½"	2'0"
s	168	-	11'0"
4 Cast Iron Rockers Lbs 1250.			
8 Steel Plates Lbs 510.			
Reinf'g Steel Lbs 34280.			
Concrete Cu Yds 139.4			

FIG. 19. Typical reinforced concrete, through girder superstructure, showing details of expansion rockers and pockets as arranged for a two span structure. Clear span, 45 feet; clear roadway, 18 feet. Bill of material for two spans.

Fig. 14 shows an abutment of the purely cantilever type and Fig. 15 shows this type of abutment used for slab bridges in which the wings are cantilevers and the main wall a vertical slab.

In practically all reinforced concrete abutments where the wings may be placed nearly parallel to the roadway or make an angle of more than 45 degrees with the face of the abutment, the wing walls are considered to act as counterforts and the reinforcing steel in the main wall is horizontal and placed near the stream face of the wall. Fig. No. 16 shows an abutment of this type. This results in economy except when very wide roadways are used, in which case, the span of the main wall slab from wing to wing may be so great as to make the cantilever type of main wall more economical.

In case the wing walls are parallel with the roadway, economy is frequently secured by designing the wings as vertical slabs supported at the bottom by the footing and at the top by a section of the wall reinforced as a horizontal beam. This horizontal beam is then supported at intervals by tie rods across the roadway which are surrounded by concrete. The excavation for this type of abutment is much less than for the cantilever type as but little, if any, footing is required for the wings beyond the usual width. This type of abutment is illustrated in Fig. 17, also by plate No. 30.

All abutments and retaining walls are designed in accordance with the method of equivalent fluid pressures proposed by Turneaure and Maurer in "Principles of Reinforced Concrete Construction." An equivalent fluid pressure of 15 pounds per square foot is assumed for main and wing walls of all abutments unless the wings are parallel or nearly parallel to the main wall, in which case an equivalent fluid pressure of 21 pounds per square foot is used. For all work thus far built, the use of the above equivalent fluid pressure in designing seems to have provided designs of ample stability.

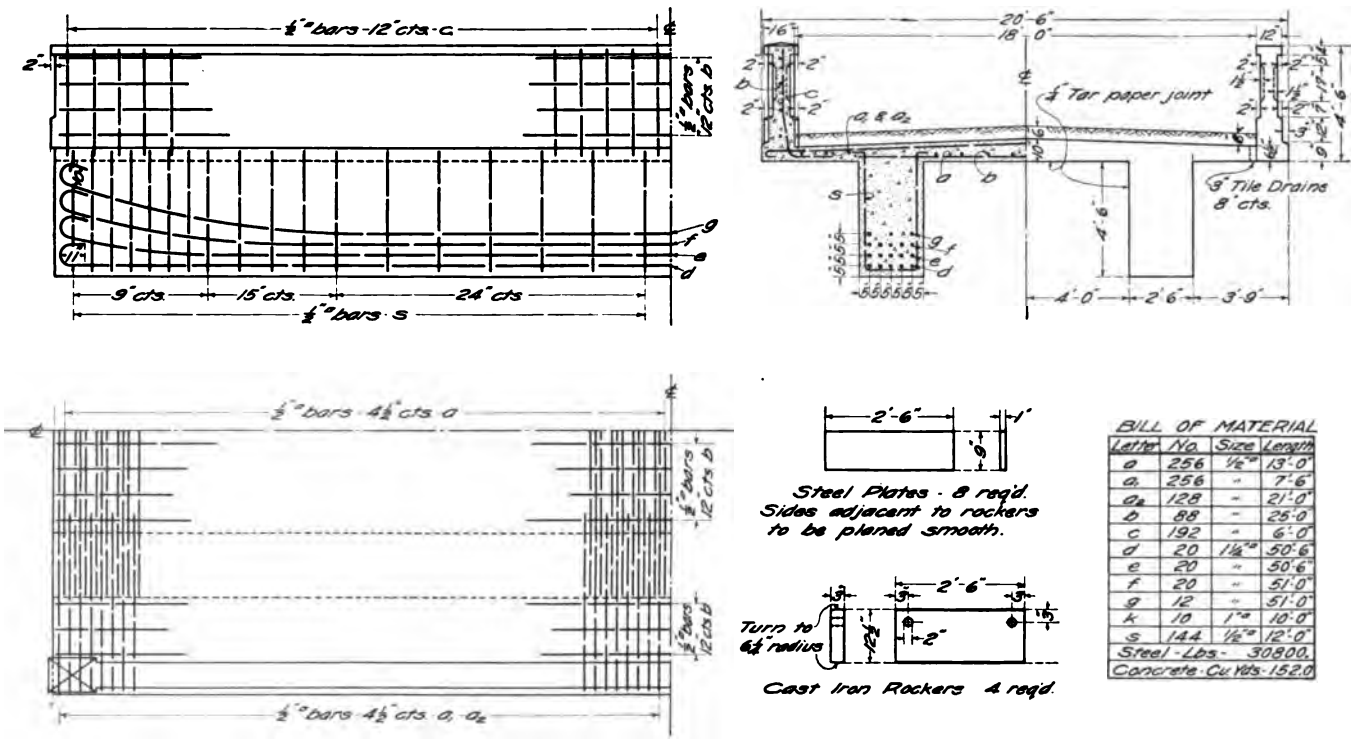
Figures Nos. 18, 19 and 20 illustrate respectively the type of slab, through girder and deck girder superstructures now in use.

BRIDGES BUILT AND THEIR COST.

Tables 31, 32, 33, 34, 35 and 36 give a complete list of the steel and concrete bridges contracted or placed under construction during the years of 1910, 1911 and 1912. The actual cost to the local community of each bridge including all extras, if any were incurred, is given in these tables for all bridges let by contract. Complete and reliable data in regard to the cost of day labor work could not be obtained and are therefore omitted.

Many of the bridges contracted in 1912 were not completed when the table for this year was made up and the final cost of these may vary somewhat from that given, depending upon the necessity which may be found for extras or deductions.

Tables 37 and 38 of cost data of concrete bridges built in 1910 and 1911 respectively, include all work on which reliable data were obtained.



BILL OF MATERIAL

Letter	No.	Size	Length
a	256	½"	13'-0"
a1	256	"	7'-6"
a2	128	"	21'-0"
b	88	"	25'-0
c	192	"	6'-0"
d	20	1½"	50'-6
e	20	"	50'-6
f	20	"	51'-0"
g	12	"	51'-0"
k	10	1"	10'-0"
s	144	½"	12'-0"
Steel - Lbs - 30800.			
Concrete - Cu Yds - 152.0			

FIG. 20. Typical reinforced concrete, deck girder superstructure. Clear span, 45 feet; clear roadway, 18 feet. Bill of material for two spans.

Such tables can be only of general interest as local conditions may largely affect individual items. Some valuable deductions can be made however of the effect of good or poor management by comparing costs of certain items for bridges of the same general dimensions, such as the item of forms or mixing and placing, which are not largely affected by length of haul, etc. These data include items which go to make up the total cost of concrete only. Overhead expenses, except traveling expenses, are not included as few of the contractors engaged in this work maintain an office or other central organization.

THE USE OF GRAVEL FOR CONCRETE.

The bridge work of the Illinois Highway Commission involves the use of concrete under a great variety of conditions. The quality of concrete required varies from that necessary in massive plain concrete abutments and retaining walls to that required for light, thin reinforced floors for steel bridges.

The conditions under which concrete is built varies throughout all seasons of the year, and the location of the work may be in a city with ample transportation facilities, or it may be twenty miles from a railroad with dirt roads and steep grades intervening.

The quality of available aggregates may be the best of crushed limestone and coarse river sand, or it may be gravel of infinitely varied character.

The quantity needed for the work may also be anything from a few cubic yards to several thousand.

In order to handle the construction of a large number of concrete structures under greatly varying conditions it has been found necessary to devise a set of specifications for concrete work which will provide for concrete of satisfactory quality under all circumstances, and yet be elastic enough to admit of the use of a considerable variety of aggregate.

When the bridge is located comparatively near a railroad station, it is frequently possible to secure broken stone and sand at a reasonable cost. Many country highway bridges, however, are located perhaps five, ten or fifteen miles from a railroad, in which case if broken stone and sand were required, the cost of concrete structures would be beyond the reach of many communities.

The admission of gravel for aggregate permits of the economical use of concrete in practically all Illinois townships, however remote from stone supply. Gravel as nature provides it, has, however, an infinitely varied mixture of sand, pebbles and stone. Gravel as known to local highway officials, and to most contractors, may in some cases contain stone from 3 inches in diameter down, while in others it may be a material all of which will pass through a $\frac{3}{8}$-inch or even a $\frac{1}{4}$-inch screen. It is all popularly known as gravel, and in spite of the wide variation of its quality, the standard mixture is one of cement to 6 or 7 of gravel.

The abuse of gravel concrete in small country highway work is astonishing. One local contractor, who was building a small bridge, insisted that a proportion of 1 of cement to 6 of gravel meant one sack of cement to 6 wheelbarrows of gravel.

The specifications adopted and printed in full in the 1908-1909 report, provides for the use of broken stone and sand when available by stating the number of parts by volume of each ingredient. Screened gravel is treated in the same way. Unscreened gravel is also permitted under certain conditions.

The clay or loam content is limited by the specifications to 2 per cent of the sand, thus few natural gravels will satisfy this requirement. Larger percentages are frequently allowed if the gravel is otherwise of good quality.

To secure the necessary strength in gravel concrete, the cement is proportioned in accordance with the amount of sand contained in the gravel; sand being defined as that part of the gravel which will pass through a ¼-inch screen. The only requirement as to relative proportions of sand and stone in the gravel is that the volume of sand must not fall below 0.6 of the volume of stone. Any gravel, therefore, having a sand to stone ratio greater than 0.6 may be used without modification, but for gravel so used the cement to sand ratio must be constant for a given class of concrete. It is necessary, however, to watch the grading of the sand content of the gravel to see that there is a sufficient proportion of the finer particles, that is, those below 1/16-inch. Though usually gravel sands contain an excess of finer particles, there has been encountered occasionally a gravel that lacked a sufficient amount of the smaller grains to make a good mortar.

The use of practically all gravels composed of satisfactory material is usually possible under the above provisions. The resulting proportions stated in the usual form may vary, for a certain class of concrete, from 1 part cement to 2½ parts sand and 4 parts of stone to a mortar mixture of 1 part cement to 2½ parts sand.

This method of proportioning is based on the assumption that if the sand and the stone are of satisfactory quality, and the ratio of sand to stone is equal to, or greater than 0.6, the strength of the concrete will be satisfactory, providing the ratio of cement to sand, or in other words, the mortar is always maintained constant for a given class of concrete. The specification for gravel concrete reads as follows:

Gravel may be used in the place of broken stone and sand for concrete and when so used shall conform to the following requirements.

Gravel used for concrete shall consist of clean, hard and sound stone, pebbles and sand, having a reasonably uniform gradation from the coarsest material allowable for the work specified to fine sand, and shall be used and proportioned in the following manner:

"In proportioning gravel concrete, frequent tests will be made to determine the proportion of sand and stone. For Class X and Class A gravel concrete all material which passes a ¼-inch screen will be considered sand, and all material which is retained on a ¼-inch screen and passes a 1-inch screen will be considered stone. For Class B gravel concrete all material which passes a ¼-inch screen will be considered sand, and all material which is retained on a ¼-inch screen and passes a 2½-inch screen will be considered stone.

For any of the above named classes of concrete, should the volume of sand so found be less than 60 per cent of the volume of stone, sufficient sand shall be added to bring up the proportion of sand to stone to 60 per cent. Should the volume of sand be more than 60 per cent of the volume of stone, sufficient stone shall be added to reduce the proportion of sand to stone to 60 per cent or sufficient cement shall be added so that the volume of cement to sand shall be for Class X concrete as 1 to 2; for Class A concrete as 1 to 2½, and for Class B concrete as 1 to 3. In any case the proportion of cement to sand shall be as stated for the various classes of concrete."

In discussing the methods used in proportioning gravel concrete, the following definitions and notations will be used:

Pit run gravel—A natural mixture of sand and stone.

Sand—That part of pit run gravel which will pass through a ¼-inch screen.

Stone—That part of pit run gravel which will be retained on a ¼-inch screen and which will pass through a screen of size indicated for the given class of concrete.

Total aggregate—The mixture of sand and stone as it is to be used, with the addition of cement to form concrete. This may be pit run gravel alone or pit run gravel modified by the addition of sand or stone to form a more economical mixture.

x=volume of sand contained in a unit volume of pit run gravel expressed as a decimal.

y=volume of stone contained in a unit volume of pit run gravel expressed as a decimal.

One barrel of cement=3.8 cubic feet.

There are two general cases to be considered. First, when $\frac{x}{y}$ is less than 0.60. In this case sand must be added, according to the specifications so that $\frac{x}{y}$ in the resulting mixture will be 0.60. As gravel of this character is not often found, and the treatment is simple, no further comment on gravels of this character is necessary.

Second, when $\frac{x}{y}$ is greater than 0.60. In this case sand is in excess and according to the specifications either of two methods of proportioning may be adopted.

First, the pit run gravel may be used without adding stone, by adding a sufficient amount of cement, so that the ratio of cement to sand always remains as required in the specifications for the class of concrete under consideration.

Second, sufficient stone may be added to the pit run gravel so as to make the ratio of sand to stone in the resulting aggregate equal 0.60.

The following formulæ may be used to determine the amount of cement to use, or the amount of stone to be added to the pit run gravel under the second general condition, that is, where the pit run gravel has an excess of sand.

Class A concrete is mixed, 1 cement, 2½ sand and 4 parts rock, if gravel is to be used the number of sacks of cement to use per cubic yard of pit run gravel equals

$$\frac{27 \text{ times } x}{2.5 \text{ times } 0.95} = 11.37\,x \quad \ldots\ldots\ldots\ldots (1)$$

The number of barrels would be $\frac{11.37\,x}{4}$ equals $2.84\,x$.

The number of cubic feet of stone to be added to each cubic yard of pit run gravel, if this method of proportioning is used, equals

$$\frac{27 \text{ times } x - 27\,y}{0.6} = 45x - 27y \quad \ldots\ldots\ldots (2)$$

If stone is added according to this formula, the amount of cement to use per cubic yard of the modified aggregate cannot be determined accurately without finding a new value of x. To find the new value of x, calling this value x_1, add to a given sample volume of gravel the proper amount of stone found by formula (2) and mix thoroughly. Knowing x, the actual volume of sand (Sd) in the sample used may be determined, and if, after the stone is added, the volume (V) of modified aggregate may be measured, then x_1 equals $\frac{Sd.}{V}$.

As a comparatively large portion of gravel should be used, it may not be convenient to measure the volume of the modified aggregate. In this case a definite portion of the modified aggregate after thoroughly mixing may be screened and x_1 determined in the same manner as used in determining x for unmodified gravel. After finding x_1, the amount of cement to be used per cubic yard of modified gravel may be found by substituting x_1 for x in formula (1).

For the other classes of concrete, similar formulæ may be written.

Sometimes it is convenient to proportion gravel concrete by relative volumes of cement and total aggregate.

To determine this relation, first compute the number of sacks of cement per cubic yard of the aggregate as it is to be used in the mixture; then the volume in cubic feet of cement per cubic yard of aggregate equals 0.95 of the number of sacks and the proportion of cement to aggregate equals 27 divided by this quantity.

The following examples will illustrate the use of the above formulæ:

Example 1—Assume that it is decided to use for Class A concrete, pit run gravel having an excess of sand, which is the usual condition; that the test measurements are made in a box having vertical sides; that the selected sample of gravel, which should be well compacted, fills the box to a depth of 10 inches; that the sand, after screening, fills the box to a depth of 7 inches and the stone to a depth of 4 inches. As the sides of the box are vertical, then 10, 7 and 4 represent the volumes of gravel, sand and stone respectively. The ratio of sand to stone

$\frac{x}{y}$ equals $\frac{7}{4}$ =1.75. This being greater than 0.60, sand is therefore in excess. x = 0.7, y = 0.4 and using formula (1), the amount of cement to use per cubic yard equals 11.37 times 0.7, or 7.96 sacks. Proportioning by volumes, the amount of cement to pit run gravel is as

$$1 \text{ to } \frac{27}{7.96 \text{ times } 0.95} \text{ or 1 to 3.6.}$$

Example 2—Assume that we have the same gravel, but that it is decided to add stone, so as to reduce the amount of cement necessary. Using formula (2) the amount of stone to add to each cubic yard of gravel equals 45 times 0.7 minus 27 times 0.4 or 20.7 cubic feet.

Assume now that stone is added to a quantity of gravel at the rate of 20.7 cubic feet to the yard of gravel and that again screening a sample, we find that in 10 inches of gravel we have 4.5 inches of sand and 7.5 inches of stone. The ratio of sand to stone then equals $\frac{4.5}{7.5}$ = 0.60. If this result should not come out about 0.60 it would indicate that some error existed in making the determination for stone.

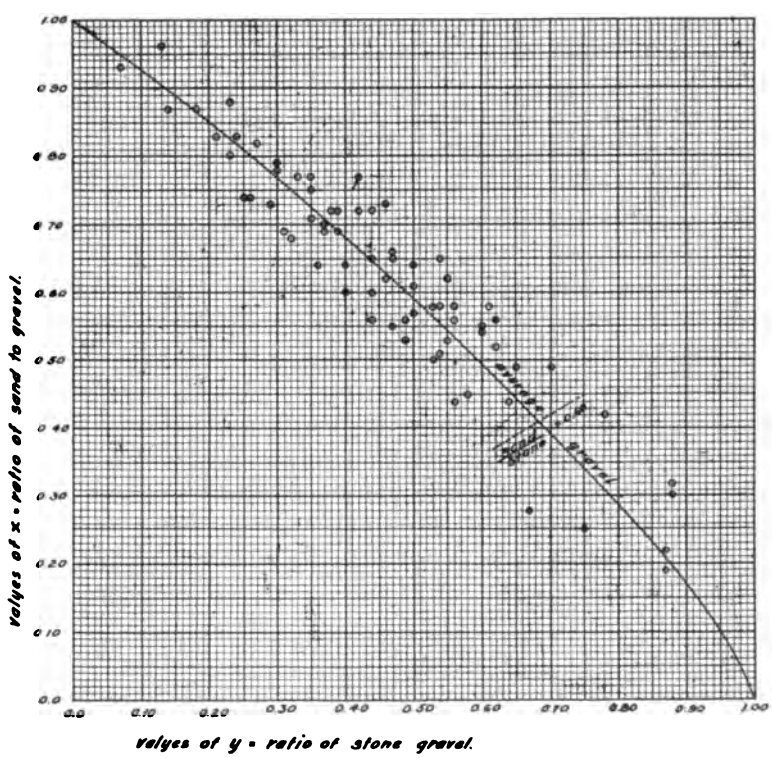


FIG. 21. Showing values of "x" and "y" for seventy samples of Illinois gravels.

Some variation might be expected, however, because of the nonuniformity of the materials. X_1 now equals $\frac{4.5}{10} = 0.45$ and the amount of cement to use per cubic yard of the modified aggregate is 5.1 sacks.

Having determined x or x_1 for any given aggregate, the number of sacks of cement to use per cubic yard of aggregate or the number of volumes of total aggregate to one volume of cement may be taken from Figs. Nos. 23 and 24 respectively.

Fig. No. 21 shows the analysis of seventy samples of gravel; values of x or ratio of sand to gravel being plotted as ordinates, values of y or ratio of stone to gravel, as abscisses. The average gravel curve is shown by a full line. The short dotted line passes through points having a ratio of sand to stone of 0.60.

Any gravel falling below 0.60 line is deficient in sand and sand must be added. Any gravel falling above this line has an excess of sand and additional cement must be used or the gravel modified by adding stone or by screening.

Fig. No. 22 is designed as an aid in determining the quantities of material to provide in case screening is resorted to or rock is to be added when sand is in excess.

Having determined x and y by screening a sample of the gravel, find the value of $\frac{x}{y}$. Entering the diagram with this value, the amount in cubic yards of stone and pit run gravel which will make one cubic yard of aggregate having a ratio of sand to stone of 0.60 may be found by reading from the proper curves to the left of the diagram.

The quantities so obtained are closely approximate for any gravel which falls near the average line of Fig. No. 21. The maximum variation, is not more than 5 per cent for any of the gravels so far analyzed.

For all ordinary cases, therefore, these values are sufficiently close. The quantities taken from Fig. No. 22 are those which, when mixed, will make up one cubic yard of aggregate. The cement, when added to this cubic yard of aggregate may produce a somewhat greater volume of concrete, the amount of variation depending upon the voids in the aggregate. The quantities obtained from this diagram should be accurate enough for making an estimate of the amount of material to provide, as there is always some loss in hauling and handling.

It is often cheaper to resort to screening in order to obtain the stone necessary to modify the gravel to the 0.60 ratio than it is to add cement or purchase broken stone.

Using Fig. No. 22 again, with the value of $\frac{x}{y}$ and reading from the curve marked "Cubic yards of gravel to screen" to the right, the number of cubic yards of gravel necessary to screen to obtain the stone required per cubic yard of aggregate of 0.60 ratio may be obtained. The values so obtained are very nearly correct for gravels which fall close to the average gravel line of Fig. No. 21. For other gravels the

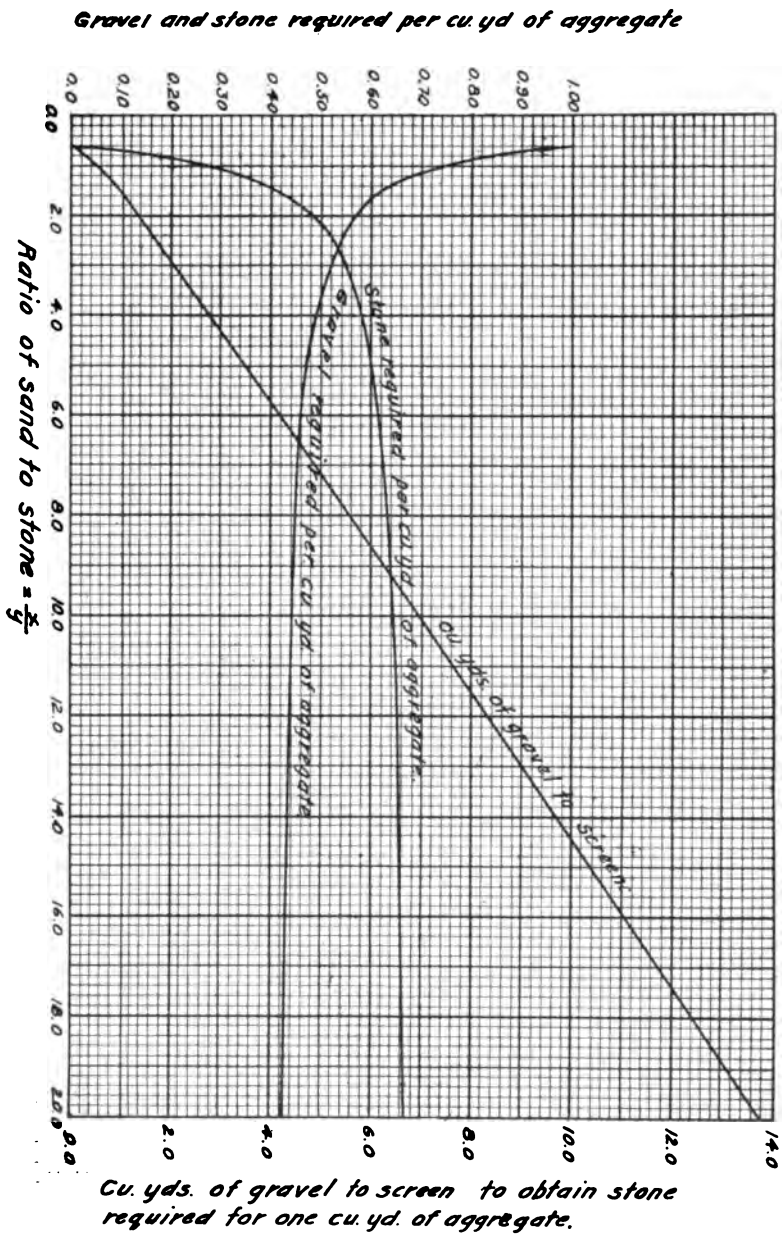

Gravel and stone required per cu. yd of aggregate
Ratio of sand to stone = x/y
Stone required per cu. yd. of aggregate
Gravel required per cu. yd. of aggregate
Cu. yds. of gravel to screen
Cu. yds. of gravel to screen to obtain stone required for one cu. yd. of aggregate.

FIG. 22. Showing amount of gravel and stone required to make one cubic yard of aggregate in which x divided by y equals 0.6; also number of cubic yards of gravel to be screened to obtain the necessary stone.

variation may be considerable, particularly for gravels having a value of $\frac{x}{y}$ not much greater than 0.60. If, therefore, the process of screening gravel to obtain the necessary stone, as determined in this way, does not show a marked economy, a more accurate determination of the number of cubic yards to screen should be made. To do this, find the

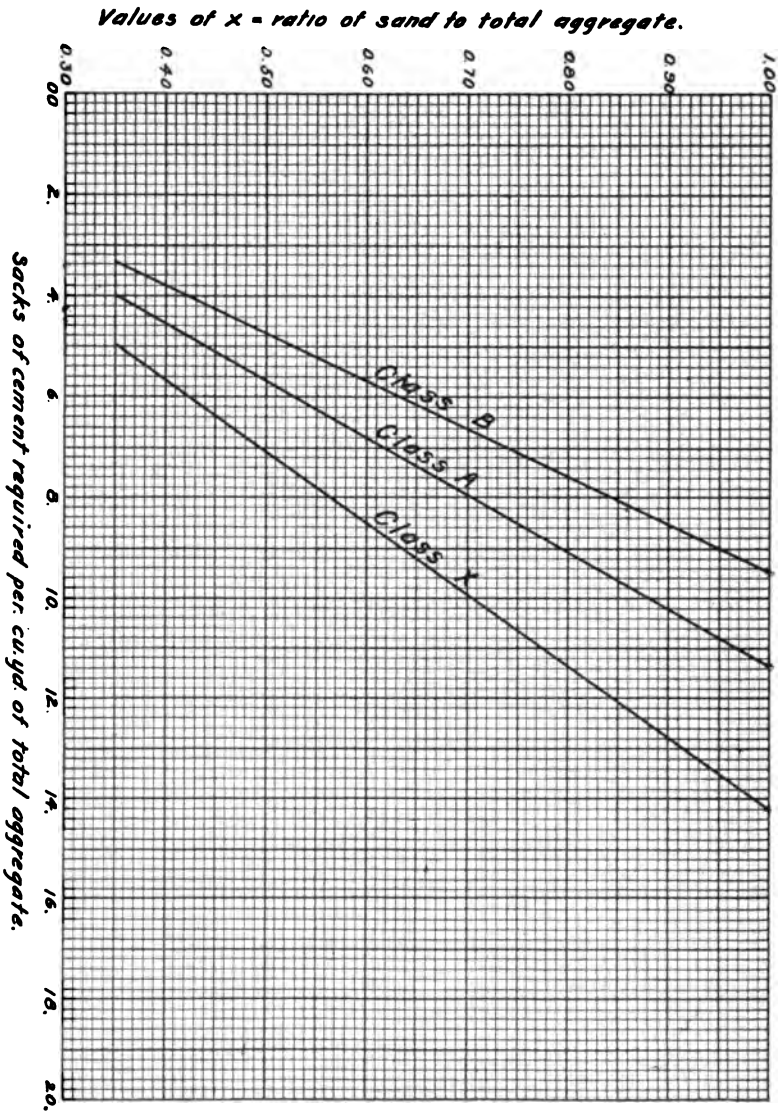


FIG. 23. Showing quantities of cement in sacks to use per cubic yard of total aggregate.

amount of stone to add to make up a cubic yard of aggregate from the left of Fig. 22, calling this value St. Then the number of cubic yards of gravel to screen to obtain this amount of stone $= \frac{St.}{y}$.

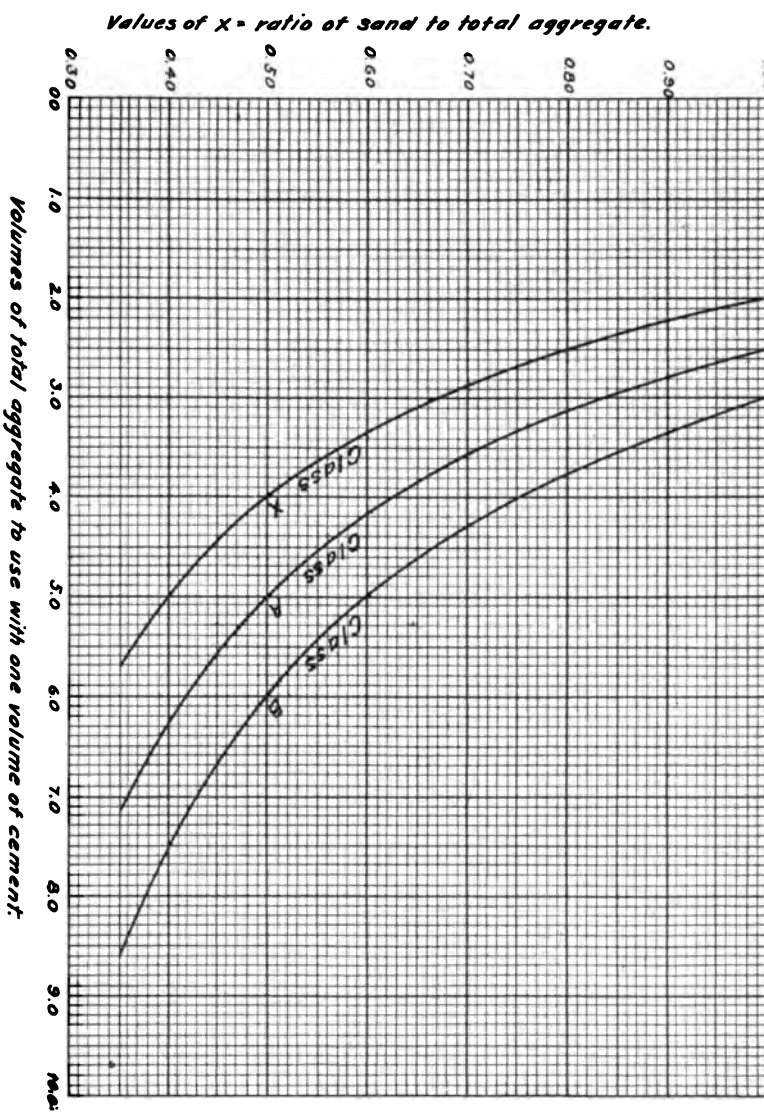


FIG. 24. Showing volumes of total aggregate to use with one volume of cement.

By using Fig. No. 23 to determine the amount of cement required per cubic yard of pit run gravel and Fig. No. 22 to determine the amount of stone to add so that the minimum amount of cement will

be required, and finding the gravel to screen in order to obtain the required amount of stone from Fig. No. 22 or the formula $\frac{St}{y}$, then the cost of cement, broken stone, gravel and screening a cubic yard of gravel being known, the most economical method of proportioning may readily be determined.

Fig. No. 25 shows graphically the relative cost of the different methods of proportioning under certain given conditions. The curves are based on the average gravel values taken from Fig. No. 21.

With cement at $1.00 per barrel on the ground and 30 cents as the cost of screening one yard of gravel, presuming that the gravel is free at the pit or that it is necessary to purchase only the amount of gravel hauled away, it will be seen that screening is cheaper than adding cement up to where $x = 0.90$. With cement on the ground at $1.50 per barrel and screening at 30 cents per yard, gravel being free at the pit or the material hauled away only being paid for, there is a very marked saving in cost by screening up to $x = 0.93$.

With cement at $1.50 per barrel, screening at 30 cents and gravel at 40 cents, all gravel screened as well as that hauled being paid for at this rate, it is still cheaper with values of x not exceeding 0.85 to screen the gravel in order to secure additional stone than it is to add cement.

With cement at $1.50 and broken stone at $2.00 per yard delivered at the bridge site, the addition of broken stone is cheaper than additional cement, cheaper than screening, if all gravel handled must be paid for at the rate of 40 cents per cubic yard and is cheaper than screening alone for values of x greater than 0.80.

An example of a somewhat unusual case where the method of adding cement proved considerably cheaper than any other method of proportioning occurred as follows:

A bridge located about nine miles from the nearest railroad station required about 350 cubic yards of Class A concrete. Cement was delivered at the bridge site at cost of $1.35 per barrel. At the site of the bridge occurred a deposit of gravel containing but a small amount of stone, the sand, however, being of excellent quality. The gravel was obtained for the cost of shoveling it into wheelbarrows. Broken stone at the nearest railroad station would have cost $1.75 per cubic yard, and the haul on account of the grades would have cost $4.00 per cubic yard, making the cost of broken stone at the bridge site $5.75 per cubic yard. The gravel in the creek bed tested 0.93 sand and 0.12 stone.

Using the gravel as it occurred in the creek bed required the use of 2.6 barrels of cement per cubic yard of concrete, the cost at $1.35 per barrel being $3.51 per cubic yard. Had broken stone been added, it would have been necessary to purchase about 0.7 cubic yards per cubic yard of concrete. This would have cost at the bridge site $4.02. The cement necessary would have been reduced to 1.2 barrels and would have cost $1.62 per cubic yard of concrete. The cost of cement and stone per cubic yard of concrete would have been about $5.64. The saving effected per cubic yard of concrete by adding cement at the rate of 1

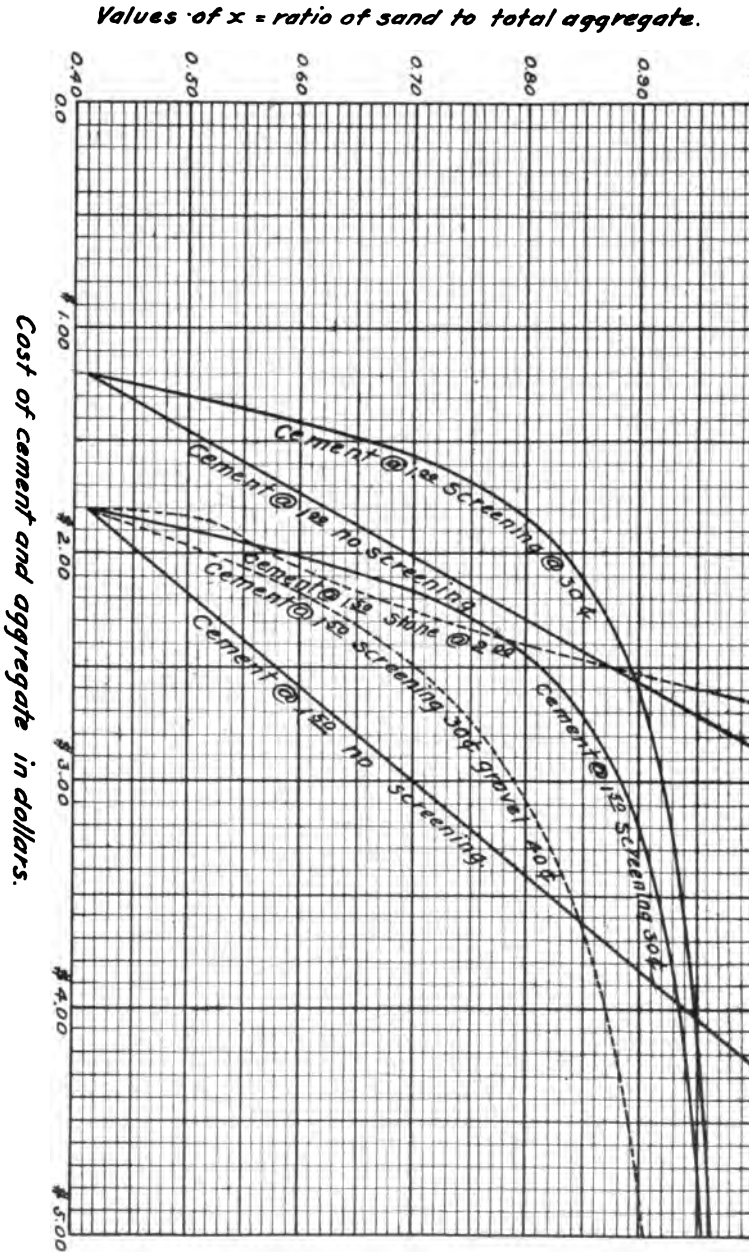


FIG. 25. Illustrating cost of cement and total aggregate with different methods of proportioning.

of cement to 2½ of the contained sand amounted to $2.13. As there were 350 cubic yards used, the total saving amounted in this case to $745.00. The resulting concrete appears to be excellent.

Screening was out of the question, as to obtain the stone required would have necessitated screening nearly 1,800 cubic yards of gravel, and the visible supply was much less than this.

In general this specification for gravel concrete, which has been in use by the Illinois Highway Commission for several years, has resulted in satisfactory concrete, and made concrete structures available in many places where the cost would have been prohibitive had a fixed ratio of sand to stone been required in all cases.

CREOSOTED TIMBER FOR BRIDGE FLOORS.

The largest item of expense in connection with the up-keep of steel bridges, not having concrete or other permanent floors, is that of floor maintenance.

Until a few years ago, the floor almost universally specified for country highway bridges consisted of white or burr oak plank, from 2½ to 3 inches in thickness. When first class material could be obtained at a cost of $25.00 per thousand feet board measure, such floors proved to be fairly economical if not subjected to heavy traffic. But now it is almost impossible to obtain at any price a good quality of white or burr oak bridge plank.

The lightest concrete floor that can be designed to carry modern traffic with safety, weighs 40 pounds or more per square foot, and in order to protect such a floor from excessive wear and to distribute concentrated loads sufficiently so that they will not produce local failure, a wearing surface of gravel, macadam or brick weighing a minimum of fifty pounds per square foot is necessary.

Steel bridges carrying plank floors are rarely, if ever, designed to carry more than the dead weight of the bridge itself, which includes about 12 pounds per square foot for the floor, and a live load of 100 pounds per square foot, provided by law.

To place a concrete floor on a steel bridge, designed to carry a plank floor would impose, therefore, an additional dead load on the structure amounting to the difference between 90 pounds per square foot, the weight of the concrete floor and wearing surface, and 12 pounds per square foot the weight of a plank floor, or about 78 pounds per square foot.

Should this be done, it may readily be seen that the live load permissible would be only 22 pounds per square foot which is much less than the load required by law and much less than that required by modern traffic.

Many bridges are examined by the State Highway Commission each year to determine whether or not a concrete floor may be placed on them with safety. Up to the present time, no bridge so examined has proved strong enough to carry the concrete floor with safety.

As there are in Illinois a great number of wood floor, steel bridges in existence, considerable study has been devoted to determine the best method of maintaining the floors of such structures.

The requirements to be met are as follows: The proposed floor must weigh but little more than the floor for which the structure was designed.

It must not be unduly expensive, and it must be as durable as possible.

The material which best meets these requirements seems to be timber treated with creosote oil to prevent decay.

All woods treated with creosote oil seem to resist decay equally well. Any wood may therefore be used which is susceptible to the creosote treatment, and which will resist the wear coming upon it.

For existing wood floor, steel bridges, located in or near cities, which carry a considerable amount of traffic, it is recommended that a creosoted wood block pavement be laid on creosoted pine sub-plank.

Such a floor weighs about 30 pounds per square foot. This is about 18 pounds per square foot in excess of the floor weight a majority of wood floor steel bridges are designed to carry. However, as this type of floor is very much smoother and stiffer than the ordinary plank floor, the reduction of vibration due to heavy moving loads is greatly decreased. This is a factor of safety which will balance somewhat the greater dead weight of the structure. However, a careful investigation of the strength of the bridge should be made before a floor of this character is laid.

At present prices for material, this type of floor can be laid for about four times the cost of a 3-inch plank floor.

If the conditions of wear are such as would require the replacement of an ordinary plank floor every three years, the creosoted block floor would be cheaper than plank floors providing that it will last more than 12 years. If proper materials and workmanship are used, there is little question but that such a floor will last for a much longer period; possibly 25 or 30 years.

For existing bridges in good condition and of proper design, located on roads at some distance from a city, carrying a moderate amount of traffic, a floor consisting of 3-inch creosoted sub-plank on which is placed a wearing surface, about ¾ of an inch thick of fine gravel or stone chips flushed with heavy asphaltic filler, will be found serviceable and economical. Such a floor, if properly constructed, will present a smooth, elastic surface which will reduce vibration. A floor of this character weighs but a few pounds per square foot more than a 3-inch, oak plank floor and is far more durable. The wearing surface will probably require renewal, at intervals of from 2 to 6 years depending upon traffic conditions. The Spring street bridge, city of Galena, Jo-Daviess County, shown on plates Nos. 23B and 23A was refloored in this manner.

As the wearing surface may readily be renewed by day labor, at a cost of about 50 cents per square yard, the item of maintenance is small compared with the cost of maintaining an untreated plank floor.

The total first coat of a floor of this character amounts to about 2½ times the cost in place of an untreated plank floor. If then, the conditions of decay and wear would require the replacement of an ordinary plank floor, in say four years, a floor of creosoted plank protected by a bituminous wearing surface would be more economical than an ordinary plank floor if it would last about twelve years.

There is no reason why a floor of this character should not last as long as a creosoted block floor, providing the sub-plank is kept protected from wear by a properly maintained wearing surface.

For existing country highway bridges, in good repair and of sufficient strength, where traffic is light and little wear comes upon the floor. creosoted oak plank with no special wearing surface can often be used.

Red oak can be used to advantage for this purpose as it is readily susceptible to treatment with creosote oil, wears less than a softer wood and will probably last as long as far as decay is concerned as any other creosoted timber.

In this connection, it is worthy to note that the rate of wear on an ordinary plank floor, greatly increases with the age of the plank owing to the softening of the wood as decay advances.

As the creosote treatment protects the plank from decay, a floor of this character will wear better than a floor of untreated material as the wood remains hard and resistant until decay sets in.

A creosoted plank floor costs a little less than twice as much as ordinary plank floors. If then an ordinary plank floor will require renewal at intervals of about six years, which is a fair average for floors where decay is the most important factor, the creosoted plank floor is more economical, if it will last twelve years or more.

In the light of the above discussion, it is therefore well to hold in mind the following points:

1. Old steel bridges are rarely, if ever, strong enough to carry with safety a concrete floor.
2. For existing steel bridges in good condition and of satisfactory design, located in cities or elsewhere where traffic is heavy and ordinary plank floors rapidly wear out, it will be found economical to refloor with creosoted sub-plank and creosoted blocks.
3. For existing steel bridges in good repair and of satisfactory design carrying moderate traffic, but yet where wear is of considerable importance, it will be found economical to use creosoted plank with a bituminous wearing surface.
4. For existing steel bridges in locations where an ordinary plank floor rots rather than wears out, a creosoted plank floor with no special wearing surface will be found economical.

If a proper selection of floor is made and the material used is subjected to rigid specifications and inspection, this floor should in most cases outlast the steel bridge on which it is placed.

Creosoted lumber might also be used to advantage for building small bridges and culverts in communities where, owing to a lack of funds, a structure must be built, at the lowest first cost possible. Small bridges built of this material should be very much more durable than ordinary

wood structures, probably comparing favorably with steel for this purpose. Such structures should cost less than if built of any material other than untreated wood.

COST OF ENGINEERING WORK FOR BRIDGES.

A sufficient volume of bridge work has been handled by the State Highway Commission together with experience in organizing the engineering work force that it is possible to give some reliable data as to the cost for this class of service rendered the public.

In making up the cost of this work, everything is charged out of the appropriation made to the department that was necessary because of the bridge work. All of the men engaged on this work, their traveling expenses, a proportionate amount of time of all clerks and stenographers, as well as other expenses, have been included. The cost is based upon the work handled during the years including 1910, 1911 and 1912. The work is divided into two principal parts: office work, which includes the preparation of plans, specifications and estimates; and the field work, which includes preliminary inspections and supervision during construction. There has been charged to the field work, all the preliminary inspections made, although these include a considerable number of inspections on which nothing further is done, thus somewhat increasing the cost of field supervision proper on bridges under construction.

It will be appreciated that if this department had authority over the construction of bridges and could itself plan the work, it could be handled more efficiently than under the present system whereby it is wholly at the option of the local officials and plans prepared at such times as they may be ready. But under these conditions, it is believed that the work has been economically carried on for the class of service rendered, and the public has received a benefit many times more than the total cost of all engineering work done upon bridges. This cost is seen from the following statement:

TABLE NO. 30.

Cost of Engineering for Bridge Work for 1910, 1911 and 1912.

Number of bridge plans and specifications prepared	658
Value of bridge work for which plans and specifications were prepared	$1,119,132 00
Number of bridges contracted and bridges constructed by force account	418
Cost of bridge work contracted or built by force account	$600,029 00
Cost of preparing plans and specifications	21,200 00
Cost of field inspection of construction	55,900 00

From the above, it will be noted that the cost of preparation of plans and specifications and estimates is 1.88 per centum of the value of work for which such plans, specifications and estimates were prepared.

The cost of supervision in the field, which includes the cost of an engineer on the work during the entire period of construction equals 9.32 per centum of the total cost of the bridge work actually built.

New Wilson street east bridge, city of Batavia, Kane County.

End spans, 60 feet; center span, 80 feet; roadway, 60 feet. Piers and abutments founded on rock. Built in 1911. Cost, $30,500.00. Carl J. Ekmann and John McKimmie, Batavia, Illinois, contractors. Sub-let to McCarty Brothers, Davenport, Iowa. Designed by the Illinois Highway Commission.

It will be noted that plans, specifications and estimates have been prepared at the request of local officials for a considerably larger amount of work than was actually put under construction. It is assumed, however, that this information was desired by the local officials for some real purpose and whenever they should decide to put these structures under construction, this part of the work will have been done and cannot therefore properly be charged only to bridges that have actually been built.

TABLE NO. 31.

List of Steel Bridges Contracted in 1910 Under the Supervision of the Illinois Highway Commission.

Name.	County.	Township.	Span.	Roadway.	Finished roadway to bottom of footings.	Cost.
Haskell	Bureau	Wyanet	110	16	17½	$4,378 00
Villa Grove	Douglas	Camargo	100	16	22	4,251 20
Kimes	Edgar	Grandview	70	16	.....	2,677 00
Pine Bluff	Grundy	Goose Lake	75–100	16	.....	5,100 00
Gore	Grundy	Saratoga	75	16	17½	3,500 00
Lewis Shearer	Henry	Munson-Cornwall	80	16	19½	4,594 60
Smith	LaSalle	Serena	100	16	17	3,390 00
Wedron	LaSalle	Dayton	2–150	16	.....	*2,900 00
Mans	Madison	Foster	40	14	14½	1,089 50
Spring Lake	McHenry-Cook.	Algonquin-Barrington	2–75	16	10	4,239 71
Rock River	Ogle	Oregon	900	18	.....	†6,500 00

* Cleaning, painting, new floor and repairs to abutments.
† Cleaning, painting and reflooring with creosoted block pavement.

TABLE NO. 32.

List of Concrete Bridges Contracted in 1910 Under the Supervision of the Illinois Highway Commission.

Name.	County.	Township.	Span.	Roadway.	Finished roadway to bottom of footings.	Cost.
Motter	Adams	Clayton	20	20	12	$1,031 00
Cemetery	..do	..do	10	20	11	526 60
Coulter	Bureau	Ohio	8	20	9	432 00
Prutseman	..do	..do	6	20	11	528 00
Crossman	..do	..do	8	20	13	636 00
Kasbeer	..do	..do	20	18	12	804 00
Shugart	..do	Princeton	16	24	12	989 00
Pewee	..do	..do	24	18	11½	1,149 00
Wetbeck	Boone	Flora	20	16	8½	580 00
Will Hartman	Carroll	Fairhaven	24	16	13½	947 00
Swaggart	..do	Salem	20	20	13	822 80
Finlayson	..do	..do	30	16	14	1,097 00
Stock	Cass	Road Dist. No. 8	6	20	11	Day labor
Miller	..do	..do	6	18	16	Day labor
Rausch	..do	Road Dist. No. 1	10	16	15	620 00
Fox	..do	Road Dist. No. 8	5	18	9	367 43
Shiloh Church	..do	Road Dist. No. 2	5	18	11	342 68

Table No. 32—Continued.

Name.	County.	Township.	Span.	Roadway.	Finished roadway to bottom of footings.	Cost.
Redshaw	Cass	Road Dist. No. 8	8	18	13	$ 449 18
Leeper	..do	Road Dist. No. 3	8	20	20	994 00
Crawford	..do	Road Dist. No. 4	5	24	14	470 00
Swanson	DeKalb	Sycamore	8	16	8	135 00
West	..do	Victor	38	16	13	Day labor
East	..do	..do	38	16	13	Day labor
W. Road	Effingham	Douglas	6	ext'd 6 ft.	.....	Day labor
Karman	..do	Banner	3	26	3½	131 00
McDaniel	..do	..do	5	16	9½	232 00
Dennis	..do	..do	5	16	9½	232 00
Strong	Ford	Patton	6	16	7½	140 54
Peter Johnson	..do	..do	14	16	8½	Day labor
Croft	..do	..do	20	16	13	682 00
Apland	..do	..do	12	16	8	639 33
Chas. Wesland	..do	..do	20	16	11	639 33
Lindall	..do	..do	30	16	16½	639 33
Stockdale	..do	Sullivan	22	16	10½	1,396 00
Stuhmer	..do	..do	8	16	7½	390 00
Stein	..do	..do	10	16	8½	515 00
Brucker	..do	..do	10	16	7	375 00
Johnson	..do	..do	10	16	7½	385 00
Knetkovsky	Grundy	Braceville	6	20	8	Day labor
Gleghorn	..do	..do	5	24	6	Day labor
Sulphur Springs	..do	Maine	3-50	16	27	5,919 64
Boyle	Henry	Geneseo	22	16	14	1,090 00
Priebe	..do	..do	16	20	12½	812 60
Dresher	..do	..do	10	20	8½	913 80
Keane	Henderson	Raritan	14	16	14	Day labor
Laut	..do	Stronghurst	20	16	15	998 00
Marshall	..do	..do	6	16	13	380 00
Powells	..do	..do	18	16	11	602 00
Kauffman	Iroquois	Loda	60	16	14	2,036 50
Richwood	Jackson	Somerset	50	16	19½	2,150 00
Cross	Jersey	Jersey	12	16	10	Day labor
Crone	..do	..do	16	16	12	Day labor
Brown	..do	..do	9	16	13	Day labor
Ryan	..do	Ruyle	25	16	14	1,031 00
Beolk	JoDaviess	Rush	20	18	10	923 00
Darnell	Kendall	Fox	10	16	12½	593 00
Sunwall	Knox	Truro	14	16	11½	620 00
Hanawalt	..do	..do	14	16	11½	620 53
Rice	..do	..do	14	16	11½	620 53
Prairie Creek	..do	Lynn	20	16	15½	948 00
Bradley	..do	..do	34	16	15½	1,267 00
Reed	..do	Henderson	20	16	14½	994 00
Skokie	Lake	Shields	30	20	15	1,857 00
Ringer	LaSalle	Otter Creek	10	16	8	305 00
S. Otter Creek	..do	..do	12	20	8½	551 61
Henry	..do	..do	20	16	10	589 90
E. Main street	..do	..do	10	30	8½	555 26
Thompson	..do	Rutland	30	18	16½	1,832 80
Betz	..do	Mendota	16	18	9	1,565 16
Besier	..do	..do	14	18	14	1,565 16
McGary	..do	Earl	50	16	15	2,132 50
Allen	Livingston	Newton	20	16	11	604 56
Dice	..do	..do	10	18	7	312 00
Leonard	..do	..do	12	18	7	296 00
Anderson	..do	Pike	15	16	8	638 00
Elson	..do	..do	18	16	9	702 00
Bauman	..do	..do	16	16	9½	700 00
Roberts	Macon	Niantic	10	16	8	Day labor
Quady	Madison	Olive	30	18	15½	1,478 00
Grant Ford	..do	Lee-Saline	60	16	17½	2,469 80
Gebhardt	..do	Edwardsville	26½	16	Old stone	407 00
Bosen	..do	..do	16	25	Old stone	290 00
Meier	..do	Omphghent	10	16	12½	621 00
Heidman	..do	..do	8	18	15	835 52
Columbia Church	..do	Hamel	18	18	10½	736 79
Cemetery	..do	..do	12	20	8	755 80
Smith	..do	Godfrey	16	16	16½	669 00
Long	..do	..do	8	16	11	378 38
Wagner	..do	..do	10	16	15	678 70

Table No. 32—Concluded.

Name.	County.	Township.	Span.	Roadway.	Finished roadway to bottom of footings.	Cost.
Bartlett	Madison	Godfrey	6	16	10	$ 342 00
Charles	..do	..do	6	20	10½	413 00
Walters	..do	..do	28	16	18½	1,510 00
Detton	..do	..do	10	16	12	530 00
Pilcher	..do	..do	5	20	13½	666 63
Kreider	..do	Olive	25	16	16½	1,693 65
Severs	..do	..do	30	18	15	1,569 95
Bartels	..do	Moro	12	16	13¾	780 00
Riggins	..do	Collinsville	12	16	13	715 00
Dead Mans	..do	..do	12	16	13	780 90
N. Broadway	Marion	Salem	40	20	15	2,920 00
Pansing	Massac	R. D. No. 5	42	16	16	1,693 50
Grinnell	..do	..do	30	16	14½	1,751 00
Korte	..do	R. D. No. 2	40	16	14	1,330 00
Lake	..do	R. D. No. 1	40	16	17½	2,531 75
Oakes Bayou	..do	R. D. No. 5	20	16	27	2,156 80
P. O. Johns	..do	R. D. No. 4	2-60	16	17	4,240 88
Porep	McHenry	Hebron	12	16	8½	673 00
Slavin	..do	..do	12	18	9	673 00
Riesborough	Ogle	Monroe	8	16	10⅜	449 00
Baker	..do	..do	18	16	Old stone	325 00
Farber	..do	..do	14	16	10½	534 81
Schutte	Randolph	R. D. No. 3-2	12	16	9	Day labor
Morrison	..do	R. D. No. 3	14	16	11	Day labor
Biebel	St. Clair	Smithton	6	16	16	Day labor
Grossman	..do	..do	16	16	16	Day labor
Miller	..do	..do	10	16	11½	Day labor
Bartloth	..do	..do	10	16	10½	Day labor
Wolf	..do	..do	12	16	14½	Day labor
Bridge No. 1	..do	O'Fallon	8	16	7	Day labor
Bridge No. 2	..do	..do	6	16	6	Day labor
Bridge No. 3	..do	Mascoutah	11½	40	Old stone	606 40
Bridge No. 4	..do	..do	12	125	Old stone	1,743 93
N. Walnut st	Sangamon	Springfield	3-45	20	18	7,901 50
Miller	Tazewell	Elm Grove	6	20	11½	866 60
Crooks	..do	..do	8	18	17½	1,155 00
Lynn Creek	Whiteside	Garden Plain	24	16	12	Day labor
Fox	Will	Troy	30	16	8½	1,500 00
Bridge A	..do	Monee	26	16	10½	975 00
Bridge B	..do	..do	24	16	10½	895 00
Blume	Woodford	Worth	24	16	12½	1,224 00

TABLE NO. 33.

List of Steel Bridges Contracted in 1911 Under the Supervision of the Illinois Highway Commission.

Name.	County.	Township.	Span.	Roadway	Finished roadway to bottom of footings.	Cost.
Loraine	Adams	Keene	81	16		$ 2,100 00
Summers	..do	Melrose	90	16	22	3,250 00
Pritchard	Henry	Alba-Atkinson	140	16	17	5,484 05
Robinson	..do	Alba	120	16	16	4,348 50
Cox	JoDaviess	Rush	100	14	15	4,408 00
Spring street	..do	Galena	237	16		*1,700 00
Birds	Lawrence	Bond	30	16	12	1,006 40
Waters	..do	..do	30	16	14	1,075 00
Miller	..do	..do	60	16	16	2,224 00
Wampler	..do	..do	28	14	14	869 00
Canteen	Madison	Nameoki	60	16	15½	1,856 00
Cahoki No. 1	..do	Edwardsville	2-60	24	30	13,368 75
Cahokia No. 2	..do	..do	150 2-60 150	16	30	13,368 75
Cahokia No. 3	..do	..do	150 2-60 150	16	30	13,368 75
Cahokia No. 4	..do	..do	150 2-60 150	20	30	13,368 75
Crabb	McDonough	Macomb	70	16	22	3,190 00
Park avenue	Winnebago	Roscoe	141	20		†2,222 20
N. End bridge	..do	Rockford	5-103	22		‡4,830 00

* Painting and reflooring with creosoted lumber and bituminous wearing surface.
† Painting reinforcing and placing concrete floor.
‡ Painting and reflooring with creosoted blocks.

TABLE NO. 34.

List of Concrete Bridges Contracted in 1911 Under the Supervision of the Illinois Highway Commission.

Name.	County.	Township.	Span.	Roadway.	Finished roadway to bottom of footings.	Cost.
Dradge	Adams	Richfield	40	16	17	$1,607 00
Selters	..do	Clayton	35	16	12	1,088 96
Frost	..do	Camp Point	12	20	22	1,775 00
Hiles	Brown	Lee	12	18	10½	496 00
Wilson	Bureau	Princeton	10	24	11	645 00
Borop	..do	..do	10	24	11	645 00
Thomas	..do	..do	16	24	10	660 00
Carlson	..do	..do	12	24	10	645 00
Maln	..do	..do	14	20	11½	570 00
Kitterman	..do	..do	5	26	11	430 00
Krupp	..do	LaMoille	50	16	15	2,277 20
Grady	..do	..do	50	16	14	1,572 80
Adolph	Carroll	Fairhaven	24	16	15	1,538 80
Ashby	..do	Mt. Carroll	40	16	14	2,086 50
Geo. Peters	..do	Rock Creek	40	16	14½	1,595 00
Drenner	..do	Salem	16	16	11	611 20
St. Paul	..do	..do	32	16	18	1,401 80
Warner	Cass	R. D. No. 8	6	20	11½	575 00
Turner	..do	..do	4	18	11½	387 00
Nigger Creek	..do	R. D. No. 7	8	20	8½	370 56
Gilbert	..do	..do	6	16	9½	405 00
Sugar Grove	..do	..do	8	16	10	429 44
Logue	..do	R. D. No. 2	5	20	9	272 00

Table No. 34—Continued.

Name.	County.	Township.	Span.	Roadway.	Finished roadway to bottom of footings.	Cost.
Wilkey	Cass	R. D. No. 1	6	20	9½	$ 284 00
Matthews	..do	..do	6	16	11	532 00
Bell	..do	R. D. No. 8	6	16	9½	316 00
Andrew	Cook	Northfield	42	20	14½	2,450 00
Vollmar	..do	Rich	22	18	.....	348 00
Meyer	..do	..do	8	20	9	486 00
Mahler	..do	..do	14	18	.....	184 00
McFadden	..do	..do	15	16	7½	318 00
Ahlerking	..do	..do	10	20	8	464 00
Mahler Wall	..do	..do	75 long	.....	10 high	545 00
Bridge No. 1	Crawford	Robinson	10	16	7	Day labor
Maple Grove	DeWitt	Santa Anna	2-40	18	14	2,945 00
Meyers	Ford	Patton	18	16	11	670 00
Bankson	..do	..do	12	16	9	455 00
Cleary	..do	..do	14	16	10	480 00
Martwet	..do	..do	8	16	8½	351 00
Fritty	..do	..do	8	16	9	472 00
Chas. Nelson	..do	..do	8	16	9	464 00
Westbrook	..do	..do	10	16	10½	425 00
Henry Taylor	Hancock	Carthage	20	16	13	830 00
Jackson	Henry	Munson	24	16	13	950 00
Ainsworth	Iroquois	Belmont	35	16	12	1,360 00
Coney	..do	..do	35	16	12	1,436 00
Woodland	..do	..do	3-50	18	37	9,846 84
Hodel	..do	Pigeon Grove	50	16	13	2,175 00
White	..do	Stockland	5	20	6½	300 00
Jones	..do	..do	8	16	8½	300 00
Kirby	Iroquois	Iroquois	8	40	15	1,302 49
Miner	JoDaviess	Nora	23	16	15	1,109 34
Dawson	..do	Berreman	50	16	15½	2,197 00
Wilson street E. bridge	Kane	Batavia	2-60 1-80	60	Arch	30,500 00
Voga	LaSalle	Mission	16	20	8½	400 00
Fruland	..do	..do	16	20	8½	419 76
Waterwell	..do	..do	30	20	12½	1,200 00
Stasell	..do	Otter Creek	20	16	10½	893 20
Strawn	..do	..do	10	16	9½	480 00
Ottawa st. br.	..do	Earl	50	20	17½	2,521 26
W. Olive st.	Lawrence	Bridgeport	16	30	9	500 00
Bridge No. 1	..do	..do	4	20	6	Day labor
Bridge No. 2	..do	..do	8	20	6	Day labor
Bridge No. 3	..do	..do	2	20	4	Day labor
Full	Lee	May	22	16	11	839 00
Deterding	Madison	Collinsville	26	16	.....	383 00
Blume	..do	..do	16	16	12½	823 00
Station 78+15	..do	..do	10	24	14	Day labor
Groenemeyer	..do	..do	8	20	17½	1,071 00
Gus Blome	..do	Olive	20	18	12	750 00
Boyles	..do	..do	6	16	8	390 00
Ernest Blome	..do	..do	20	18	12	740 65
Coalson	..do	..do	40	18	14½	1,740 00
Smith	..do	Ft. Russell	8	18	11	297 50
Neikamp	..do	..do	4	20	6	297 50
Preuitt	..do	..do	3	20	7	297 50
Schake	..do	..do	5	20	7½	297 50
Hahnekamp	..do	Fosterburg	8	18	14½	823 00
Bettman	..do	Hamel	12	16	14	744 00
Bartlett	..do	..do	10	16	10½	400 00
Blume	..do	Omphghent	14	18	15	989 00
Green Farm	Massac	Road Dist. No. 2	2-40	16	.....	4,602 60
Township line	..do	Road Dist. No. 2-3	40	16	.....	1,400 00
School street	Montgomery	Hillsboro	2-20	30	.....	2,939 25
Seward st. walk	..do	..do	600	5	.....	2,543 60
Lane	Rock Island	South Moline	12	20	.....	622 00
Quick	..do	Coe	28	16	.....	1,206 00
Main street	Stephenson	Pearl City	27	22	.....	1,301 00
Burns	St. Clair	O'Fallon	10	16	.....	792 00
Reinhardt	..do	Lenzburg	8	20	.....	Day labor
Bert	..do	New Athens	22	16	.....	916 80
Lucash	..do	Freeburg	24	16	.....	1,745 00
Heberer No. 1	..do	..do	12	16	.....	1,745 00
Market street	..do	Mascoutah	9	44	.....	697 90

Table 34—Concluded.

Name.	County.	Township.	Span.	Roadway.	Finished roadway to bottom of footings.	Cost.
Yentes	Tazewell	Tremont	30	16		$ 993 67
Lackland	..do	..do	40	16		1,298 00
Bridge No. 1	..do	Elm Grove	8	16		1,189 00
Bridge No. 2	..do	..do	12	16		1,189 00
Coles Creek	..do	East Peoria	2-19	40		5,079 25
Edland	Whiteside	Ustick	24	22		1,251 00
Baker	Will	Manhattan	10	16		708 98
Rellwood	..do	..do	28	16		1,028 00
Pfundstein	..do	..do	23½	16		1,320 80
Walsh	..do	..do	40	16		1,631 00
Walsh, Jr	..do	..do	8	16		405 00
Sanders	..do	Peotone	36	16		1,240 00
Myron Adams	..do	Crete	30	16		1,075 00
Darby	..do	Custer	25	16		1,274 44
E. Cazenovia	Woodford	Cazenovia	14	20		695 00

TABLE NO. 35.

List of Steel Bridges Contracted in 1912 Under the Supervision of the Illinois Highway Commission.

Name.	County.	Township.	Span.	Roadway.	Finished roadway to bottom of footings.	Cost.
Edgewood	Bureau	Princeton	150	18	25	$7,038 00
Star†	Brown	Cooperstown	147	16		4,890 00
Dame‡	Carroll	Salem				*350 00
Pine Bluff§	Grundy	Goose Lake				1,739 40
Green River	Henry	Colona	150	16	19½	*5,800 00
Potters	..do	Hanna	130	16	20	*5,600 00
Illinois Riverö	Mason	Havana				2,802 00
Lipkamon	Pike	Perry	100	16	16	3,033 40
Mackinaw Delle	Woodford	Montgomery	160	16	26½	*7,250 00

* Bridge not finished, final cost subject to a possible variation due to extras or deductions.
† Superstructure only.
‡ New floor only.
§ New pier only.
ö Painting and new floor.

TABLE NO. 36.

List of Reinforced Concrete Bridges Contracted in 1912 Under the Supervision of the Illinois Highway commission.

Name.	County.	Township.	Span.	Roadway.	Finished roadway to bottom of footings.	Cost.
Jansen	Adams	Houston	16	16	11½	$ 611 00
White	..do	North East	25	16	18	1,235 00
Simpson	..do	..do	22	16	14	1,082 75
Hawks No. 2	Bureau	LaMoille	12	18	11	*579 19
Midwood	..do	..do	50	16	14½	2,085 00
Flowers	..do	..do	2-40	16	20½	3,440 00
Byrne	..do	..do	30	18	15	*1,213 28
Lamb	..do	Ohio	24	16	10½	*700 00
Ross	..do	..do	18	16	16	*1,015 00
Ernest Smith	..do	..do	16	18	8½	*580 00
Black	..do	Walnut	12	18	10	405 00
Sandberg	..do	..do	8	18	9	320 00
McLaughlin	Carroll	Freedom	20	20	20	*800 00
Dyslin†	..do	..do	.....	.....	18½	*671 00
Beattie	..do	Salem	12	20	10½	600 00
Durham†	..do	Woodland	.....	.....	16	*693 00
Davis	..do	..do	14	18	11	Day labor
G. F. Bellows	..do	Wysox	40	16	15	*1,398 00
M. A. Hanna	..do	..do	40	16	16	*1,429 00
Heimsbaugh	..do	..do	40	16	16	*1,180 00
Jorner	..do	..do	40	16	16	*1,445 00
Seim	..do	York	40	16	15	1,540 00
McHenry	Cass	Road Dist. No. 5	8	20	16	*1,239 70
Cunningham	..do	Road Dist. No. 6	30	20	18	*2,490 00
Tureman	..do	..do	18	20	14	*1,252 00
Hall	..do	Road Dist. No. 7	20	18	14	1,186 10
Baxter	..do	Road Dist. No. 2	50	16	23	*2,607 00
Black Sea	Cook	Addison	20	18	13	930 00
Rittmueller	..do	..do	12	18	7	568 80
Ryan	Cumberland	Union	4-50	16	31½	9,500 80
Reeser	DeWitt	Santa Anna	10	30	7½	368 04
Washburn	..do	..do	12	30	7½	427 48
Kincaid	..do	..do	12	30	8½	547 53
Stansbury	..do	..do	2	30	6½	126 79
Porter	..do	..do	2	30	5	70 78
McCord	..do	..do	2	30	5½	103 22
Haas	..do	..do	6	30	7½	359 04
Redwood	..do	..do	2-50	16	13	3,365 40
Redwood Wall‡	..do	..do	.....	.....	.....	960 75
Station 126	Douglas	Sargent	8 ft. box	.....	.....	425 00
Unity	Edwards	Road Dist. No. 6	22	16	9	720 00
Richardson	Ford	Patton	20	16	14	792 00
Scott	..do	..do	20	16	12	670 00
Bridge No. 2	..do	Sullivan	2x2 box	.....	.....	Day labor
Bridge No. 3	..do	..do	4x6 box	.....	.....	Day labor
Bridge No. 4	..do	..do	4x4 box	.....	.....	Day labor
Station 79+3	Greene	Whitehall	6	20	10	439 60
Sharps	Grundy	Aussable	5	24	9½	727 30
Erdman	Henry	Edford	30	16	17	*1,530 00
Swanson	..do	Western	12	16	10	410 00
McDonald	..do	..do	4	20	12	700 00
Samuelson	..do	..do	10	20	11	510 00
Miller	..do	..do	10	16	12	550 00
Texas	Iroquois	Concord	3-55	16	23	*6,464 64
Sloan	..do	Iroquois	2-40	18	21	*4,242 42
Town line	..do	Milford	2-40	16	24	*4,600 00
Williams Hollow	Jersey	Quarry	30	16	13	Day labor
Carley Culvert	JoDaviess	Hanover	8	20	2	*2,500 00
Zellers	LaSalle	Dayton	24	18	12	450 00
Alexander	..do	Earl	50	16	15	2,305 00

Table No. 36—Continued.

Name.	County.	Township.	Span.	Roadway.	Finished roadway to bottom of footings.	Cost.
Hibbs	LaSalle	Grand Rapids	30	20	10	$1,437 10
Peterson	..do	Mission	2½	20	5½	
Waterwell	..do	..do	2	20	5½	
Armson	..do	..do	16	16	9½	1,804 20
Mason	..do	..do	10	20	9½	
County line	..do	..do	8	20	9½	
Rood	..do	..do	12	20	13	*700 00
Gray	..do	..do	40	20	14	*2,150 00
Henry	..do	Otter Creek	50	16	14	1,602 00
Badger Creek	..do	..do	30	16	12	954 62
Greener	..do	..do	16	16	9	532 00
West Serena	..do	Serena	2–45	18	24½	4,073 50
Clark	McDonough	Scotland	60	18	18½	*3,027 00
Chris Diederding	Madison	Collinsville	12	16	11½	383 00
Kalbfleisch	..do	..do	14	24	25½	2,547 10
Andrews	..do	..do	14	24	17	1,598 12
Sepmeyer	..do	..do	10	20	15	1,080 00
Sedlach	..do	Edwardsville	13	16	17	1,139 50
Sedlach Culvert	..do	..do	4	20	10	504 00
Wheeler No. 2	..do	..do	10	28	12	870 00
Klingman	..do	..do	12	24	26	2,395 00
Schwartz	..do	..do	15	16	13	777 00
Isken	..do	Ft. Russell	40	18	18½	*2,316 00
Stalhut	..do	..do	10	20	16	*1,086 00
Susanke	..do	..do	4	24	8½	*376 00
Hadley	..do	..do	6	20	10	*397 00
Mills	..do	Godfrey	24	18	17	*1,317 50
Henderson	..do	..do	18	18	15	*1,217 50
Watts	..do	..do	12	24	20½	*1,817 50
Weber	..do	..do	4½	20	14½	542 00
Tom Lamb	..do	Hamel	6	20	9	356 00
Buchta	..do	..do	5	20	12½	364 00
Joint	..do	..do	8	20	8	345 00
Fruit	..do	..do	6	24	9	350 00
Wirth	..do	Helvetia	8	20	13	698 80
Mantz	..do	Jarvis	40	18	16	2,248 00
Stieglitz	..do	Moro	7	24	19	1,338 00
Henry Sivers	..do	Olive	5	20	15½	*300 00
Sprangle	..do	..do	8	20	11	*498 00
Lindley	..do	St. Jacob	12	16	9½	411 50
Schupbach	..do	..do	10	16	7½	323 50
Joe Pyle	..do	..do	14	16	14	704 00
Sutter	Monroe	Maeystown	10	16	.....	Day labor
Pease	Montgomery	Butler Grove	25	18	16	1,644 60
Wood street	..do	Hillsboro	40	24	17½	3,134 00
Huntley Ford	Pike	Hadley	50	16	13	1,450 00
Winderscheidt	Putnam	Hennepin	16	18	12	*815 00
Willhouse	Rock Island	Rural	16	16	14	800 00
Cook	..do	..do	18	16	10½	479 00
E. North street	St. Clair	Mascoutah	11	60	12	1,797 50
Dry Lake	..do	New Athens	35	16	15	1,482 00
Bridge No. 3	..do	Shiloh Valley	3–30	18	12	3,509 60
Kraft	..do	Smithton	40	16	15	1,352 00
Sugar Creek	..do	..do	35	16	14	1,163 00
Wagner	..do	..do	16	16	10½	530 00
Phillips	..do	St. Clair	7 x 8	box	9	*720 00
Falbe	..do	..do	7 x 10	box	12	1,335 00
Euler	..do	Prairie du Long	10	20	.....	Day labor
Bell	Scott	Alsey	8	20	6½	*293 00
Savage	..do	..do	24	16	13	921 29
Jones	..do	..do	25	16	11	840 00
Cooksey	..do	..do	30	16	.....	Day labor
Blair	..do	Glasgow	8	20	12	538 00
Knapp†	..do	Winchester	.....	.....	22½	*541 00
Hawley Station	Tazewell	Cincinnati	35	16	16	1,671 40
Meyers	..do	..do	24	16	11	808 28
Davis	..do	Elm Grove	8	20	8½	*400 00
Dillon	..do	..do	6	20	11½	350 00
Hamans	Washington	Okawville	18	18	11	706 00
Morgens	..do	..do	12	18	10	535 00
Morgan	..do	..do	8	24	7	407 00

Table No. 36—Concluded.

Name.	County.	Township.	Span.	Roadway.	Finished roadway to bottom of footings.	Cost.
Millard Hill	Whiteside	Prophetstown	8	18	11	
S. Lindon Grove	..do	..do	12	18	12	
Lancaster	..do	..do	20	18	9	$ 2,650 00
N. Lindon Gr.	..do	..do	12	18	9	
Houch	..do	..do	8	20	12	
Greene	..do	Ustick	6	20	16	800 00
Peters	Will	Green Garden	20	16	9	700 00
Henry Woeltje	..do	..do	32	16	10½	1,190 73
Knoop	..do	Peotone	36	18	11	1,333 00
Pecatonica	Winnebago	Pecatonica	4–55	18	30‡	13,257 16

* Bridge not finished. Final cost subject to a possible variation due to extras or deductions.
† Abutments only.
‡ Retaining wall.

TABLE NO. 37.

Cost Data for Reinforced Concrete Bridges Built in 1910.

Name.	Clear opening.	Roadway.	Height of bridge.	Substructure.		Superstructure.		Total concrete in cubic yards.	Total steel in pounds.	Cost per cubic yard.								
				Concrete in cubic yards.	Steel in pounds.	Concrete in cubic yards.	Steel in pounds.			Cement.	Stone.	Sand.	Gravel.	Forms.	Steel in place.	Mixing and placing.	Excavation.	Total cost per cubic yard of concrete.
Pilcher	5	20	13½	.....	.....	.....	.....	72.5	3,564	1.92	1.66	.37	.....	1.97	1.24	2.02	1.73	10.91
Marshal Crossing	6	16	13	36.82	1,480	4.48	474	41.3	1,954	2.09	.....	.....	1.89	1.59	.97	.80	.97	8.31
Prutesman	6	20	11	39.4	1,527	6.3	567	45.7	2,094	2.15	.....	.....	1.33	1.44	.89	1.02	1.08	7.91
Crossman	8	20	13	45.69	1,938	8.52	906	54.2	2,844	2.33	.....	.....	1.91	1.24	1.05	.87	1.44	8.84
Long	8	16	11	31.8	1,196	7.44	748	39.2	1,944	1.56	.90	.66	.....	.85	1.44	1.35	.71	7.47
Heideman	8	18	15	57.4	2,365	4.69	728	62.09	3,093	2.64	1.82	0.47	.41	.90	1.19	1.02	1.07	9.52
Crook's	8	18	17½	68.7	2,815	8.4	906	77.1	3,721	2.79	.....	.....	2.37	1.82	1.15	1.27	3.51	12.91
Coulter	8	20	9	28.2	1,085	8.6	873	36.8	1,958	2.20	.....	.....	1.63	1.25	1.08	1.89	1.22	9.27
Berteloth	10	16	10½	25.78	936	8.84	999	34.62	1,935	1.77	1.57	1.43	.....	2.04	1.60	.71	.83	9.9
Detton	10	16	12	45.2	1,797	9.5	1,040	54.7	2,837	1.88	1.37	.48	.....	2.70	1.28	1.30	1.12	10.13
Wagner	10	16	15	58.8	2,300	9.6	1,015	68.4	3,315	2.04	1.69	.36	.....	3.11	1.07	2.24	4.27	14.78
E. Main street	10	30	8½	40.33	1,476	13.94	1,798	54.27	3,274	1.58	1.82	.54	.....	1.66	1.60	.70	.67	8.61
Stein	10	16	8½	24.33	855	11.7	1,193	36.03	2,048	1.72	2.31	1.18	.....	2.80	1.44	1.83	1.16	12.44
Apland	12	16	8	22.8	808	10.1	1,199	32.9	2,007	3.05	1.85	.....	.....	.....	.98	1.43	.24	7.55
Farber	14	16	10½	28.28	1,093	14.94	1,592	43.22	2,685	2.33	.....	.....	1.94	1.81	2.10	1.41	1.66	11.28
Besier	14	18	14	52.0	2,117	16.0	1,730	68.2	3,847	1.72	1.17	.....	1.43	1.67	1.26	.83	3.55	11.63
Priebe	16	20	12½	40.23	1,660	21.91	2,316	62.14	3,976	1.88	.50	.....	1.58	1.75	1.32	1.07	1.89	9.99
Betz	16	18	9	28.9	1,057	20.3	2,068	49.2	3,125	1.75	1.20	.....	1.32	3.15	1.69	1.28	1.72	12.11
Smith	16	16	16½	62.8	2,595	9.56	1,017	72.36	3,612	1.72	1.00	.45	.....	1.43	1.29	1.49	1.13	8.57
Columbia	18	18	10½	36.2	1,398	22.67	2,446	58.87	3,844	1.90	.....	1.05	1.68	1.29	1.61	1.71	1.10	10.34
Powell	18	16	11	30.4	1,128	20.85	2,874	51.25	4,002	1.96	.....	.....	1.88	1.50	1.55	.75	.70	8.34
Witbect Corners	20	16	8½	40.0	1,575	26.7	2,666	66.7	4,241	1.72	.....	.....	1.25	1.80	1.49	1.17	.89	8.32
Beolk	20	18	10	29.0	1,098	28.5	3,057	57.5	4,155	2.80	.....	.....	3.72	2.07	1.80	1.53	1.77	13.69
Prairie Creek	20	16	15½	55.87	2,280	26.68	2,810	82.55	5,090	2.18	1.45	.30	.....	1.98	1.57	.85	.65	8.98
Laut	20	16	15	26.69	2,817	50.94	1,997	77.63	4,814	1.87	.....	.....	1.57	1.43	1.26	1.00	.62	7.75
Swaggert	20	20	13	31.15	3,383	48.35	1,828	79.5	5,211	2.32	.....	.....	1.25	.91	1.28	1.02	.72	7.50
Kasbeer	20	18	12	28.92	3,106	39.5	1,584	68.42	4,690	2.19	.....	.....	1.31	1.41	1.34	.96	.79	8.00
Chas. Wesland	20	16	11	29.8	1,113	26.6	2,807	56.4	3,920	2.82	1.86	.59	.....	2.36	1.15	1.33	.21	10.32
Oaks Bayou	20	16	27	26.7	2,812	149.4	13,593	176.1	16,405	2.11	.....	.....	0	1.82	1.81	.95	.98	7.67
Stockdale	22	16	10½	46.45	1,884	53.55	7,655	100.0	9,539	1.27	2.82	1.67	.....	2.52	2.02	2.74	2.04	15.08

Boyle	22	16	14	37.05	1,614	30.89	5,050	67.94	6,620	2.01	.82	.59	.....	.92	2.28	1.82	2.75	11.19
Will Hartman	24	16	13½	46.79	2,065	30.89	5,050	77.7	7,071	2.85	.....	.....	2.04	1.45	2.11	1.17	1.03	10.65
Bridge "B"	24	16	10½	35.72	1,580	30.89	5,050	66.61	6,630	1.86	2.11	.90	.....	1.78	2.23	1.16	.82	10.86
Blum	24	16	12½	45.13	1,909	30.89	5,050	76.02	6,915	2.13	.....	.....	1.96	2.46	3.14	1.29	1.29	12.27
Ryan	25	16	14	56.8	2,539	32.2	5,100	89.0	7,639	1.60	1.44	.79	.....	1.69	2.17	.54	.75	8.98
Bridge "A"	26	16	10½	42.83	1,746	32.2	5,100	75.03	6,846	1.80	1.86	.89	.....	1.71	2.09	1.30	.60	10.25
Walters	28	16	18½	93.7	3,933	37.9	9,914	131.6	13,846	1.97	1.00	.11	.....	1.47	2.99	1.28	1.81	10.64
Lindahl	30	16	16½	71.12	2,835	41.61	7,000	112.73	9,621	2.16	1.69	.....	.....	.47	1.46	1.01	.68	7.47
Skokie	30	20	15	67.6	2,998	62.9	7,660	130.5	10,658	1.77	.79	.70	.....	2.79	2 53	2.20	2.18	12.96
Grinnell	30	16	14½	60.8	2,430	41.61	7,000	102.41	9,216	2.07	.....	.....	2.06	1.29	2.03	1.20	2.77	11.42
Sievers	30	18	15	66.3	2,685	54.7	8,095	121.0	10,780	2.27	.....	.93	2.30	1.41	1.97	1.02	1.14	11.04
Finlayson	30	16	14	54.75	2,204	41.61	6,786	96.36	8,990	2.43	.....	.....	1.26	1.80	1.01	1.22	.61	8.33
Korte	40	16	14	56.9	2,447	62.35	10,925	119.26	13,372	2.27	.....	.....	.32	1.55	2.14	1.43	1.00	8.71
Lake	40	16	17½	98.7	4,053	70.35	10,925	169.05	14,978	2.10	.....	.....	1.36	3.30	1.98	.86	.80	10.40
North Broadway	40	20	15	95.9	3,572	105.3	20,578	201.2	24,150	2.03	.67	.66	1.57	2.50	2.22	1.67	1.00	12.32
Ponsing	42	16	16	78.36	3,340	62.35	10,925	140.71	14,265	1.92	.....	.....	.36	1.32	2.37	.74	.56	7.27
Kauffman	60	16	14	101.27	20,338	41.0	1,259	151.27	22,288	1.72	2.56	1.29	.....	2.60	3.56	.79	.32	12.84
Sulphur Springs	3-50	16	27	272.4	5,842	195.0	46,752	451.3	52,594	1.52	1.02	.82	.53	2.51	2.53	1.64	.55	11.12
North Walnut street	3-45	20	18	179.8	2,610	361.7	65,730	541.5	68,340	2.37	.....	.....	2.54	2.25	2.39	.80	.73	11.06
Average	.....	.....	.....	.....	.....	.....	.....	.....	.....	2.06	1.50	.75	1.60	1.82	1.73	1.26	1.27	10.16

TABLE NO. 38.

Cost Data for Reinforced Concrete Bridges Built in 1911.

Name.	Clear opening.	Roadway.	Height of bridge.	Substructure.		Superstructure.		Total concrete in cubic yards.	Total steel in pounds.	Cost per cubic yard.								
				Concrete in cubic yards.	Steel in pounds.	Concrete in cubic yards.	Steel in pounds.			Cement.	Stone.	Sand.	Gravel.	Forms.	Steel in place.	Mixing and placing.	Excavation.	Total cost per cubic yard of concrete.
Walsh, Jr	8	16	7	31.0	.....	5.5	767	36.5	767	1.40	1.32	.77	.....	1.88	.48	2.02	1.00	8.87
Turner Culvert	4	1°	11½	.....	.....	.....	.....	40.0	2,720	2.36	2.20	1.52	.79	1.76	1.47	.80	1.20	12.10
Kirby Culvert	8	40	15	.....	.....	.....	.....	90.2	7,805	1.98	2.10	.91	.29	1.72	1.63	2.58	3.94	15.15
Hahnekamp	8	18	14½	.....	.....	.....	.....	72.2	5,148	1.78	1.65	1.00	.....	1.53	2.05	1.54	1.55	11.25
White Culvert	5	20	6½	.....	.....	.....	.....	16.5	2,170	2.20	.....	.....	1.88	2.34	3.40	1.44	.31	11.57
Aohlerking	10	20	8	28.54	.....	8.36	1,298	36.9	1,298	1.13	1.23	.83	.....	.84	.77	1.04	.43	6.27
Westbrook	10	16	10½	22.8	808	10.1	1,199	32.9	2,007	1.70	.....	.57	1.17	.91	.72	1.00	1.42	7.49
Strawn	10	16	9½	25.3	890	11.9	1,147	37.2	2,037	1.96	2.01	1.01	.....	2.26	1.31	1.21	1.21	10.97
Bridge No. 1	10	16	7	20.07	102	7.3	1,037	27.37	1,139	2.09	.....	.....	3.24	1.69	.85	1.79	.77	10.43
Heberer No. 1	12	16	13	50.3	2,231	9.2	1,457	59.5	3,688	2.11	1.41	1.62	.....	.65	1.33	.62	.74	8.38
Blume	14	18	15	59.4	3,345	12.4	2,430	71.8	5,775	1.96	.....	.78	1.99	1.13	1.71	1.02	.76	9.35
Fruland	16	20	8½	27.0	990	21.82	2,314	48.82	3,304	1.90	.....	.....	.....	1.37	1.66	1.14	1.02	7.09
Voga	16	20	8½	25.81	969	21.91	2,316	47.7	3,285	1.92	.....	.....	.....	1.86	1.90	1.02	.70	7.40
Stasell	20	16	10½	50.2	2,022	40.4	6,520	90.6	8,542	2.01	2.43	1.35	.....	1.43	2.68	.94	.53	11.37
Gus Blome	20	18	12	38.72	1,695	21.54	3,700	60.26	5,395	1.80	.....	.88	2.37	.99	1.97	.83	.72	9.56
Coles Creek	2-19	40	13	272.5	5,950	202.0	26,940	474.5	32,890	2.52	.....	.....	.92	1.29	1.33	1.02	1.27	8.35
School street	2-20	30	9	154.5	.....	100.3	.....	254.8	24,785	1.56	.51	.60	1.14	1.88	2.23	1.03	.91	9.86
Edland	24	22	15	54.5	3,387	32.0	5,916	86.5	9,303	2.75	.....	.....	2.89	1.65	2.02	1.16	.87	11.34
Lucash	24	16	12	43.9	2,260	30.89	5,050	74.79	7,310	2.08	.....	.96	1.72	.47	1.89	.75	1.21	9.08
Adolf	24	16	15	63.1	3,625	26.9	4,539	90.0	8,164	1.72	.....	.....	2.82	1.91	2.69	1.36	1.34	11.84
Bert	24	16	11½	40.0	1,762	41.8	5,038	81.8	6,800	1.52	2.01	.93	.....	1.75	2.10	1.27	1.36	10.94
Yentes	30	16	13	46.2	2,035	43.3	7,821	89.5	9,856	1.45	.....	.....	2.30	2.56	2.07	1.11	2.57	12.06
Myron Adams	30	16	12	59.3	2,370	41.61	7,000	100.91	9,370	1.81	.....	.67	.88	1.56	2.74	1.96	2.02	11.64
Pfundstein	35	16	*	*	*	99.9	9,577	99.9	9,577	1.30	1.64	1.13	.....	2.87	2.08	1.70	1.60	12.32
Coney	35	16	12	51.6	2,136	53.51	9,347	105.11	11,483	2.44	.....	.....	3.11	2.28	1.46	.93	1.47	11.69
Ainsworth	35	16	12	46.8	1,935	51.33	9,347	98.13	11,282	1.96	.....	.....	3.05	1.99	2.41	.69	2.17	12.27
Sanders	36	16	11½	60.2	2,400	47.5	9,577	107.7	11,977	1.41	.82	.65	.71	1.74	2.00	1.27	2.21	10.81

Leckland	40	16	13½	60.7	2,743	74.3	11,820	135.0	14,563	1.80	.....	.....	1.84	1.14	1.37	.49	.72	7.36
Walsh	40	16	15	69.3	3,503	60.0	12,131	129.3	15,634	1.28	1.46	.78	.....	2.71	2.37	2.42	2.79	13.81
Geo. Peters	40	16	14½	72.9	3,531	60.1	12,131	133.0	15,662	2.31	.....	.....	1.42	2.78	2.50	1.29	2.88	13.18
Drange	40	16	17	85.6	3,778	61.0	12,131	146.6	15,909	2.00	.....	.....	.98	1.09	2.14	.60	1.21	8.02
Andrew	42	20	14½	65.6	3,010	111.5	16,364	177.1	19,374	1.37	1.95	.65	.....	1.50	2.05	1.17	1.31	10.00
Hodel	50	16	13	62.1	2,924	88.3	18,725	150.4	21,649	1.81	.....	.....	2.49	.81	3.62	.49	.92	10.59
Krupp	50	16	15	77.6	3,933	88.3	18,638	165.9	22,571	1.57	.....	.....	2.34	2.50	2.94	2.22	2.22	13.79
Maple Grove	2–43½	18	14	65.0	3,278	178.9	30,358	243.9	33,636	1.64	.....	.....	1.40	.94	2.70	.87	1.08	8.63
Average	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.85	1.63	.93	1.81	1.65	1.96	1.22	1.39	10.41

* Stone abutments

THE "ILLINOIS WAY" OF ROADSIDE PLANTING.*

A plan to create a vast State park system without the cost of buying land; to make a new type of scenery that will fit the "Prairie State;" and to add millions to our State wealth at a cost of $10.00 to $50.00 per mile per year.

It will bring millions of tourists to the State, make new business for farmers and merchants, increase the value of real estate every where and educate a generation of children which will prefer to live in the country.

The highest ideal that any state can cherish is to have a character of its own—not to look like all the rest of the world. One reason why Americans spend $300,000,000 a year in Europe is that Europe does not look like the United States. Scotland's big drawing card is not a poor imitation of Italian gardens, but genuine Scotch scenery—mountains covered with Scotch pine, or blazing in August with the purple bloom of Scotch heather. Our motorists go to England in May to ride between miles of English hawthorn hedges, when they are a vision in white. The "pulling power" of every state in the Union can be enormously increased if each state will preserve and intensify its most valuable scenery.

The Most Valuable Scenery is Roadside Scenery.

It is a mistake to suppose that our greatest financial asset is something rare, remote and spectacular, like Niagara, Yosemite and Yellowstone. It is true that such things bring millions of tourists and will eventually add billions to our wealth, but the great bulk of the American people will live and die without ever seeing these vast, abnormal wonders. To the ninety million inhabitants of the United States, the most important scenery is the common, everyday, familiar scenery in which we pass our lives—what we see on our way from home to office. For the roadside scenery helps unconsciously to mold our national character. To realize this you need only to repeat to yourself any song by Sir Walter Scott or Robert Burns. Scotch life, poetry, and character are inextricably bound up with pine and heather, birch and rowan, gorse and bracken—rare to us, but familiar to every child in Scotland.

* By Wilhelm Miller, Assistant Professor of Landscape Horticulture, University of Illinois.

Every State May Have Valuable And Peculiar Scenery.

Maine gets $74,000,000 a year profit from people who come to fish, hunt, and see her white pines. Florida attracts every winter hundreds of thousands of tourists who enjoy the palmettoes and the cocoanuts. Vermont makes a mighty pull in September when her gorgeous "sugar bushes" are aflame with scarlet. The Gulf states draw countless thousands to see the live oaks hung with Spanish moss. The ideal for every state is to have a type of scenery so distinct that you can tell merely from a picture what state is represented. Or, the scenery should be so peculiar that after a night's ride in the sleeper you can tell where you are by the first glance out of the window. If your glance meets century-old elms brooding over a shady roadway you know you are in New England. If the first thing that greets you is an orange tree laden with fruit, you can make a shrewd guess where you are. If your eyes meet long-leaved pines you know you are somewhere in the Atlantic Coastal Plain, probably one of the Carolinas. And so on. No state can be absolutely unique, but every state can come near it, for every state originally had a strongly marked character, and this can be restored as reverently and successfully as have the great cathedrals.

What is the Most Valuable Scenery in Illinois?

"Humph," you reply, "Illinois hasn't any scenery." On the contrary we have the finest in the world. It is true that we have no mountains, or even hills in the true geologic sense, and the Mississippi is not so spectacular within our borders as to the north. But the great bulk of our land is prairie, and the prairie is one of the greatest symbols of the infinite to be found on the earth's surface. It seems as infinite as the sea, and far more human now that man has tamed it. The one great characteristic of the American people is their breadth of view, and they get it largely from the prairies. This quality of mind, says Jens Jensen, the landscape gardener, will make the middle west the most powerful and prosperous region in the world, and breed the finest race of men. Throughout future ages the prairie will silently tend to ingrain this character into the blood and bone of the people who grow out of the richest soil in the world. And Illinois is the "Prairie State."

Do You Understand the Real Value of Prairie Scenery.

Certainly you do not, if you think man has wholly spoiled the prairie. It is easy to hold that opinion, especially after reading that charming essay by Quayle, called "The Prairie and the Sea." He mourns the wildness that is gone, but we can recreate a sample of it in a "prairie reservation." The wolves and the fires are gone, and we are glad of it. But the big features are still here—the infinite breath, the amazing fertility of the soil, and the great horizontal lines of land, wood, crops, herds and clouds. How these new middle western artists glory in those horizontal lines. Only ten years ago people thought that every-

thing horizontal must be flat, monotonous, uninteresting. Now you can feel those glorious lines in the paintings of Peyrant and Browner, the prose of Hamlin Garland, the verse of Nicholas Lindsey and Walt Mason, the music of Orne Oldberg, and the sculpture of Lorado Taft. And our landscape gardeners, like Simonds and Jensen, plant thousands of hawthorns and crab apples, so that their horizontal lines may repeat in miniature the magnificent lines of the prairie.

One of the most beautiful pictures in the world is a certain flat portion of Bucks County, Pa., with its great checkerboard of green fields varied by curving roads and lined with Pennsylvania trees and shrubs. The atmosphere is one of peace, and plenty; the homes are old and permanent, and built in a style peculiar to that part of Pennslyvania. Is it any wonder that Bucks county claimed to be the wealthiest county in the United States? But contrast this with the county in Illinois which now claims to be the wealthiest county in the Union. The roads are muddy enough to kill a horse, and there is not a single tree or shrub in sight along the roads. There is nothing to see along the highway; every shrub and flower has been cut down. There is nothing to soften or relieve the cast iron system that laid out the country in absolute, unvarying squares. The crops are rich but the homes are poor, temporary, citified, and of no style that is recognized by architecture. How can this be improved right off and at the least expense?

"If we could have," says Dean Davenport, "A propaganda for planting our roadsides with ornamental and with useful trees, interspersed here and there with groups of hardy shrubbery, it would do more than any other single factor to make our country beautiful." In other words, the most important scenery in the world is roadside scenery, because it affects the most people. And, we are not like Colorado or other mountainous states, which have scenery on every roadside laid down by nature without cost; we must create our Illinois scenery. We have three great places in which to do it—our waterways, railways and roads. The waterways are already wooded, and the railway scenery we cannot control as yet, so our great opportunity is with the roads. Two and one-half per cent of our state's area is in roads, and if we can have these planted in the "Illinois Way," we shall have the greatest state park system in the world without the cost of buying the land. Think of a people's park containing 1,950 square miles—bigger than the whole state of Rhode Island.

Pennsylvania can boast of her Pennsylvania maple, Wisconsin of her willow, Iowa of her crab apple, Minnesota of her honeysuckle, and Illinois is the home of one of the loveliest shrubs in the whole world—the prairie rose (Rosa Setigera). Every day in the year it is a never ending joy. In June its large, single flowers are a poem in pink. Throughout the year its arching stems and healthy foliage fill the eye with quiet joy. And in winter its brilliant red stems are a warm and comforting sight against the snow.

THE ILLINOIS TREES ARE THE BEST FOR ILLINOIS.

Because they will create more State pride than anything else—an honest State pride based upon real achievement, not a false pride such as Edinburgh takes in her rock which she did not build. One of the loveliest trees in the world is the tulip tree, with its cup-like flowers of yellow, marked with orange, and this noble tree reaches its greatest size in the State of Illinois. Why not plant a mile of tulip trees along some wide, smoke-free road where the trees will be a joy for centuries? Why not plant hundreds of miles with elms? If people object that very tall trees shade the road too much, let us plant the small trees that are native to Illinois, such as the flowering dogwood, crab apple and hawthorn—all of which have a wealth of bloom in May, and beautiful fruits in the autumn. Probably no one would want a mile of the western catalpa, because of its conspicuous failings, but we all want a group of it now and then for its gorgeous flowers.

"I have always been struck with the prejudice of Illinois people against trees along the roadside," says Dean Davenport. "They seem to have settled upon these as the chief cause of mud, whereas the leaves of the tree will take more water out of the ground than will the sunlight which they intercept." The one sure cure for mud is good roads, and if a good road is properly crowned, there will be no trouble from trees on the score of mud, so say highway engineers of national reputation.

Where in the world can you find more beautiful shrubs than the high-bush cranberry, and other viburnums, our shrubby dogwoods, our elders and our sumachs? They are cultivated in eastern gardens; why not along our roadsides where they belong? The flowers of trees are frequently so high up that we cannot enjoy them, but the flowers of shrubs are just at the right level to see, touch and smell. Shrubs will give us more flowers and more color the year round than anything else that can be successfully planted along the roadside.

LET US MAKE THE ROADSIDE AN ASYLUM FOR PRAIRIE FLOWERS.

What finer wild flowers are there in the world than those which once grew by the million on the prairies of Illinois—the compas plant, immortalized by Longfellow as the guide of the first explorers, the brown-eyed Susan, the sunflowers, annual and perennial, the blazing star, the Turk's cap, the western red lily, and a host of other flowers that used to glorify the prairie as far as the eye could see? In no other state, probably, have the wild flowers been pushed so close to extermination, for no other state has so large a proportion of land suitable for cultivation. The result is that the sun-loving prairie flowers have only one city of refuge, the railways, and even there they are being destroyed by fires and choked by cosmopolitan weeds—the tramps from European roadsides. Why not restore the prairie flowers to our roadsides? It may not be wise to plant a mile with any one kind of a flower. These perennials cost too much for that. But we can plant big colonies here and there between the groups of shrubbery. In other words, the prairie

A prairie roadside. We have no mountains; we must create our roadside scenery. Why not restore the kind of thing we formerly had—the lovely prairie?

flowers should be used as "fillers," and in this way they will multiply enormously, hold their own against intruding weeds, and fill every foot of roadside in the State with beauty. The prairie flowers will come back if we only give them a chance. We now mow and pasture them to death. So rare are they that one of the best nurserymen in the State says that he has not seen the shooting star since he was a child and he has never seen the prairie rose growing wild in Illinois.

How to Save What Beauty is Left.

Obviously the first constructive measure is a State law that will preserve what beauty we have before it is all gone. Our present law encourages the destruction of every native bit of roadside beauty, because it puts the work of destroying weeds into the hands of men who make no distinction between pests and harmless wild flowers. These men have only one conception of beauty—a neat, close-cropped, strip of grass. That is all very well, but we want the beauty of shrubbery and flowers too. Therefore, the control of roadside weeds and roadside planting should be put in the hands of public spirited men of knowledge and taste, like the best park and shade tree commissioners. Connecticut has a law which encourages such men to plant trees along the roadside at their own expense, and at Lakeville there is a good example of such work. Let us, therefore, try for a law that will accomplish the following results.

1. Save the shrubs and wild flowers that are now cut down every year as weeds.

2. Save big trees in the middle of the road, as Cambridge, Mass. has done with its famous Washington elm. Put a stone coping around them to protect them from wagon wheels, and place near them a permanent tasteful sign, telling their species, age, height, girth, spread, and the chief historic events they have witnessed.

3. Save all big trees on or near the roadside, as Massachusetts does. Do not allow property owners to cut down century-old trees near the roadside which are precious to all the people. Every tree within a certain distance of the roadside should belong to the State as soon as it reaches a certain size.

4. Save trees from the local tree butchers and public service corporations. Make linemen put their wires underground, or zigzag them across the road, if necessary. They now behead thousands of splendid trees, instead of carrying their wires around the tree. The local tree butcher has been foiled in New Jersey by the Shade Tree Commission Law. We still pay him 65 cents an hour to mutilate our trees beyond recovery. By this system we really encourage him to kill our trees, for the more he cuts off the more money he gets.

5. Save the vegetation at the turns. There is a new idea here which, at first sight, seems very good to automobilists, viz: to cut down all trees at the turns of the road, and plant only low bushes, so that the chauffeur can see what is around the corner. Several eastern states have passed laws compelling the removal of trees at the turns, and the results

now seen to be lamentable. The most charming part of the roadside are the turns, and if the vegetation is cut down, there is nothing left to the imagination. There is no pleasing wonderment as to what may be around the corner. We would willingly sacrifice this beauty if public safety so demanded, but it does not. For, even after the vegetation is destroyed the turns are still the most dangerous parts of the road. This has been abundantly proved in the courts, and every automobilist will declare that it is safe to go twice as fast on a straight stretch as around a turn. The eastern laws benefit only the speed maniac and spoil the road for everyone who appreciates natural beauty. Such authorities as Jensen now say that we should emphasize nature's signals at the turns by planting trees that sound a note of warning, such as red cedars and white birch. These warnings in addition to the usual ones ought to make people slow down enough to prevent accidents and to enjoy the beauty of the turns.

6. Save the roadside scenery from billboards and other advertisements, which deface the landscape and destroy values that belong to the people. Progressive cities like Los Angeles tax billboards and derive a considerable income from them. Let us not do anything drastic. We cannot abolish billboards at one stroke, but we can control them as Massachusetts does. In that state the size, position and character of billboards is regulated and no billboards are permitted within a certain distance of parks and boulevards.

Coming now to constructive measures let us consider first what will be the most valuable to the State, for the only kind of beauty worth having is that which grows out of necessity, use or reasonableness. For instance, we need shade along the roads and we need sunlight too; we need cool breezes in summer and we also need protection from biting winds in winter. If trees are planted along the roadside so as to satisfy these human needs the results will infallibly be beautiful--more so than if we start with the flowers we love the most, for a mile of roses cannot regulate sun, shade, warmth, and coolness. The five following suggestions are, therefore, made in the spirit of practical value to the greatest number of roadside users.

Why Not a Mile of Fruit Trees?

Have you ever seen a mile of apples or other fruit trees in bloom, and again in fruit? Is there anything prettier? In Germany many miles of roadside are planted with fruit trees, especially near Hanover. The fruit is sold on the spot to travelers and the profits go to maintaining roads. These roads are patrolled by policemen on motorcycles to prevent theft, but there is little trouble on this score, because the people are law-abiding. If such a scheme is too paternalistic for Illinois, why can we not permit landowners to plant fruit trees along the roadside, as part of a scheme big enough to protect the fruit growers in the enjoyment of their fruit? In California there are miles of English walnut trees planted after this system. A third way to have miles of fruit trees is to permit the Illinois State Horticultural Society, or any

other competent educational institution to plant a demonstration mile in every community where fruit growing would be profitable, and make an object lesson in the spraying, feeding, pruning and general care of fruit trees.

Think how fine a mile of red clover would look. Or a mile of blue alfalfa, pink alsike or crimson clover. Nothing could be a better advertisement of farm products of the region. Nothing could be better for the soil, since these plants get the most valuable fertilizer from the air and store it in the ground. One of the best things we can do, before planting trees and shrubs along a roadside is to have the land planted for a year or two with the most appropriate legume of the region. In many places this will be sweet clover, for the Illinois farmers in many localities no longer fear this "weed" nor despise its beauty.

Some of the noblest examples of roadside beauty in Iowa and elsewhere are long stretches of road protected from winter blasts by windbreaks of white pine, hemlock and arbor-vitae. Why not plant many miles of evergreens for winter comfort and add something to relieve their monotony, like red berries and red-twigged shrubs that will be cheery all winter against the evergreens or the snow. Among such plants are the Japanese barberry, the prairie and multiflora roses, the highbush cranberry and the red osier dogwood.

How pleasant it will be to have our roadsides filled with bird song again. We can accomplish this by planting trees and shrubs that are useful and beautiful in themselves, and also furnish food to the birds the year around. The most important of these is the mulberry, because it will call the birds away from the cherries and other more valuable crops. The dwarf juneberry has the same power, and it is cheaper to plant them along the roadside than to shoot robins. Among the most beautiful plants that have edible berries are the red cedar, choke cherry, sassafras, mountain ash, black cherry, buckthorn, black currant, raspberry, blackberry, sumach, black alder, sheepberry, elder, snowberry, fox and frostgrape, blueberry and sarsaparilla. A mile planted with such material to please the birds may prove to be more beautiful than any artificial scheme that the mind of man can conceive. For the beauty of old hedgerows sown by birds in Europe and our eastern states, is "hard to beat," and as, Mr. Jensen says, "the birds are the best landscape gardeners."

"What is the use of good roads if there is nothing worth seeing," asked an automobile owner in New Jersey. "These seaside roads where I spend my summer are all alike—mere wastes of sand, dust and weeds —and there is no inducement for anyone to go pleasure riding." On the other hand, 60,000 people go to Rochester every year to see the lilac show in Highland Park. And every year hundreds of thousands of people go to the Arnol Arboretum, near Boston, during azalea week, or rhododendron week, or viburnum week, or crab apple and hawthorn week. We cannot have azalea and rhododendron shows in Illinois, but it is perfectly practicable to grow the other shrubs and there

ought to be a big show of each within automobiling distance of every city to draw the people to the country and give them a rest and change. The English railroads run bluebell excursions, and there are bluebells enough for all the children in London. They can pick bluebells to their heart's content without harming the next year's crop. The same thing can be done in America with dog's tooth violets. Someone who reads this chapter will have the ingenuity to work out a scheme whereby people may have free flowers in at least one spot in the great State of Illinois.

How the Farmers Will Benefit.

If millions of city people go to the country every pleasant week-end to see the roadside flowers, the farmers will reap an immense profit. For the flowers will bring to their doors the wealthiest class of customers—people who buy fancy stock and produce of all kinds. The farmer's children can make pin money by raising in straight, horse-hoed rows the best flowers of the roadside, since these will be in great demand for cutting, as souvenirs of a pleasant ride. This sort of thing may make your children love the country instead of hate it, and they may prefer to live there and become great bulb growers, like Corvel of New York who has seventy acres of gladiolis, or Farr of Pennsylvania who has a huge peony farm.

A State Policy for the State Highways.

The ideal is for Illinois to be the first state in the Union to adopt a State policy of roadside planting on its 15,000 miles of State highways which will eventually become good roads. These will set the standard for the 80,000 miles of secondary roads and in ten years the whole face of Illinois can be changed. Such a policy will make Illinois the most beautiful State in the Union. Probably the best way to bring this about is for a number of citizens to subscribe enough to have a comprehensive plan of roadside planting prepared by a first class landscape gardener. The experience of Harrisburg, Pa., and many other communities that have made marvelous improvements during the last decade is that the surest way to persuade the people to vote large sums of money for public improvements, is to invest $1000.00 or thereabouts in a plan prepared by some landscape gardener who can conceive and execute a glorious vision, e.g. a great state park system. One great advantage of a state policy of highway planting is that the State will be able to control insect pests and diseases at a great saving to the community. Some farmers object to shrubbery along the roadsides, because certain shrubs harbor San Jose scale and other insects. The answer to this is that shrubs protect and feed birds, and birds keep down insects. Roadside planting will tend to encourage song birds and diminish insect pests. The birds are estimated to save the American people $420,000,000 a year by their police work. The tree sparrows alone are believed to devour 800 tons of weed seed yearly in a state the size of Iowa or Illinois.

Another advantage of a state policy of roadside planting is that the longest-lived material can be planted, even if it is the slowest growing.

The time has come to plant the pin, red, scarlet, and bur oaks for posterity, as well as ourselves, instead of such short-lived trees as the box elder, soft maple and cottonwood. This will result not only in greater dignity and beauty, but will cut down the cost of maintenance for the roadside will not be littered after every heavy wind or ice storm with huge limbs broken out of soft-wooded trees. Great saving, too, can be made by establishing a State nursery for the propagation of shrubs and wild flowers that are needed for roadside planting.

The State policy should encourage the greatest variety of beauty; no cast iron system should dominate the State and be applied everywhere The one guiding principle is to restore and intensify the native beauty of each locality. For example, in a sandy region we should have the lupine and all other sandloving flowers. Every important soil type tends to have its characteristic trees, shrubs, and flowers. The ideal is to have at least 90 per cent of our planting composed of native plants, while not more than 10 per cent should be composed of foreign species and horticultural varieties. The economic justification of this policy is that native trees, as a class, tend to live longer and cost less to care for than foreigners, since nature has adapted them to our climate and soils by experiments covering tens of thousands of years.

Such a policy will please all tastes. Some communities will want grassy road margins; others will prefer wild flowers. No expense at all may be necessary along wooded highways, if the wild sweet William, the trilliums, the bloodroot, hepaticas, and American bluebells are permitted to steal out of the woods and line the roadsides. In the wet places some of the loveliest flowers of the world will thrive without care after planting, e. g. marsh marigold, blue flag, the forget-me-nots, swamp rose mallow.

Under such an enlightened policy the weed bugaboo which scares so many people will melt away. For, in the first place, as L. H. Bailey and other authorities declare, the good farmer has nothing to fear from any weed in existence. Practically nearly all weeds can be abolished or controlled without hand pulling—simply by rotation of crops and general farm management.

In the second place, many of the plants that farmers thoughtlessly call "weeds" are beautiful flowers which are appropriate to the roadside, such as. Bouncing Bet, yarrow, and the gorgeous butterfly weed. Who ever heard of their doing any harm? These and dozens more are cultivated elsewhere for their beauty, and if we give them a fair chance they will improve almost beyond recognition. Moreover, there is a very simple way of educating the farmers of any community to see the beauty of what they have formerly despised. Spend one evening showing beautiful colored lantern slides of roadside flowers and weeds and you can convince the most skeptical of your neighbors.

The weeds that are really troublesome can be numbered on the fingers of one hand. One of them is poison ivy, which ought to be absolutely exterminated, because it causes no end of suffering and expense to those who are poisoned by touching it. Ragweed pollen is generally considered by physicians to be the chief cause of hay fever, a disease which

A prairie road made beautiful by native Illinois trees and flowering shrubs. Nature has adapted them to our climate, soil and landscape by wholesale experiments covering tens of thousands of years.